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Using Web 2.0 to enhance SME agri-food Supply Chain Management: a Tasmanian Study

by

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I. STATEMENT OF ORIGINALITY

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III. STATEMENT OF CO-AUTHORSHIP

The publications of the work undertaken in the course of this research are the following:

Liao, SJH and Marshall, P and Swatman, PMC (2012), Beyond the farmgate: identifying Tasmanian farmers Web 2.0 use in agri-food supply chain, Proceedings of the IADIS International Conference on Internet Technologies & Society (ITS 2012), 28-30 November 2012, Perth, Australia

- Junheng Steve Liao (70%) is the primary author. He proposed the initial research question, conducted the research and prepared the material for publication.

- Prof. Peter Marshall (15%) and Prof. Paula M.C. Swatman (15%) of the School of Computing and Information Systems, University of Tasmania, both provided general guidance and editing advice as supervisors.

We the undersigned agree with the above stated proportion of work undertaken for each of the above published manuscripts contributing to this thesis.

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IV. ABSTRACT

This research project investigates the potential for Web 2.0 techniques (in this context, social media and websites using very accessible and scalable publishing techniques) to support and enhance agri-food supply chains within the Australian State of Tasmania. The research is based on three major areas of focus: agricultural and food supply chains (agri-food supply chains); small and medium size enterprises (SMEs) in these supply chains; and Web 2.0.

To achieve a representative outcome, both quantitative and qualitative data were gathered from a number of sub-sectors comprising seafood, dairy, livestock, fruit and vegetable.

The empirical research process made use of three data gathering stages: 10 key informant interviews to gather expert opinion prior to broader data collection, followed by a survey of 28 Tasmanian primary producers and, after refinement of the initial model, a validation focus group.

Since the majority of the interviewees had only limited familiarity with Web 2.0, a 'typical' Web 2.0 prototype was developed and presented during the survey interviews, allowing participants to trial the Web 2.0 application in a supply chain management (SCM) environment without risking their real businesses.

The results indicate the widespread popular view of the prevalence of Internet use. The majority of interviewees had also used some types of Web 2.0 technologies, although only a limited number of participants had used this sort of ICT at a sophisticated level – most interviewees used the Internet simply to obtain information, rather than actively engaging in content contribution. In particular, few of these SMEs had applied Web 2.0 to their agribusinesses, or to their supply chain activities. This situation is starting to change, however, as fragmentary Web 2.0 SCM applications begin to appear in many key areas of supply chain management including: procurement, processing and inventory management, marketing and sales, transport and customer service, as well as in all the sub-sectors investigated – some of them as a result of involvement in this project. One fisherman even developed his own iPhone app with record keeping and traceability functions for his fishing business.

The outcomes of this project suggest that applying Web 2.0 to SCM is not only driven by economic benefit, but also by lifestyle enhancement. Perceived effort expectancy, communication quality enhancement and social & other external factors also have significant effects on the adoption decision. Moreover, the degree of those perceptions also differs by gender (though, interestingly, it was the female participants who were most techno-savvy), age, customer types and technology experience – although the relatively small size of the sample means that some of these interactions will require further testing before their generalisability can be confirmed. Interestingly, the moderating effects of gender and age are diminishing as technology becomes more readily available and easier to use – and as Information Technology literacy becomes more standard.

This research project makes two significant contributions: to theory, in terms of extending the Web 2.0 literature and the applicability of UTAUT to the field of Web 2.0; and to practice, in terms of enhancing our understanding of agri-food supply chains in Tasmania and exploring the business potential of Web 2.0 within the primary production sector.

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Chapter 1

Introduction

1.1 INTRODUCTION

The development and improvement of the agri-food industry[1] has become a central issue in dealing with the world's fast growing population, their food demands and rising food requirements (DAFF 2013b). In the 21st century – the Asian century – this is especially relevant to Australia because, by 2050, global food consumption is expected to be 75% higher than in 2007, with its Asian neighbour China alone accounting for half of the increase (DAFF 2013b). This enormous anticipated demand is far beyond current production capacity (DAFF 2013b; Rapoza 2013) and provides a tremendous opportunity and challenge for Australia's agri-food industry. Nonetheless, provoked by recent food scares and farm crisis there has been increasing concern about food safety (Jackson 2010) and growing demand of food information such as food origins and production processes (Sense-T 2013). It is clear that the issue is not only about production but also successful management of complicated agri-food supply chain (DAFF 2013b).

The management of agri-food supply chain, is related to food security as both SCM and food security have a common interest in iendtifying the ways to enhance the competitive competence of firms in agri-food industry (Aji 2010).

Food security: the *"ready access to adequate quantities of safe and nutritious food"* has been one of the most important foci of government and industry effort in the last few years (AusAID 2012). The UN Secretary-General's High-Level Task Force on the Global Food Security Crisis (HLTF) was created in response to a dramatic rise in global food prices (UN 2011). While this initiative is primarily focused on developing nations, the Comprehensive Framework for Action produced by the HLTF is relevant to all food-producing nations, offering sound advice on how to improve output from smaller farms to enhance the quality and quantity of healthy food (UN 2008) – something many developed nations, with their increasing focus on agricultural profitability, seem to have forgotten.

All commentators agree that food security is a necessity and requires immediate attention if we are to avoid worldwide famines later this century, but there is considerably less agreement on how to solve the problem. Lucas & Fontanella-Khan (2012) summarise the view that

[1] Because there is no generic term which covers this disparate group of sub-sectors, the term "agri-food industries" will be used to refer to all the sub-sectors involved in natural food production, and "agri-food supply chain" to refer to their supply chains in this thesis.

involvement by major industrial groups based on intensive agriculture, technology and genetically-modified crops is the only effective way of dealing with a looming global food shortage. Other commentators believe this 'solution' is what created the problem in the first place and instead advise taking a local, low-tech approach to food production. Tudge (2012), for example, is passionate about the dangers of high-density agribusiness:

"farming designed to maximise wealth is diametrically opposite in structure and technique to farming that is intended to feed people ... apply these dogmas [finance capitalism and neoliberalism] *to agriculture and you don't get mixed, low-input, skills-intensive farms. You get maximum inputs of oil-based fertilisers and pesticides with minimum labour – which leads us to monoculture, because complexity is impossible without skilled husbandry"(Tudge 2012).*

And while Tudge's views might seem radical – perhaps even revolutionary – they are echoed by the Why Hunger project, an initiative supported by the Community Food Projects Competitive Grants Program of the US National Institute of Food and Agriculture. One of that project's five themes is Food Systems and Agriculture: *"a regional, diverse agricultural base is key to a secure food system that responds to the needs of the entire community. Producing, processing and purchasing food closer to the market translates to a stronger local economy, reduced fuel use, a healthy environment and access to fresher foods*" (WhyHunger 2012).

In the Australian context, awareness of the issue of food security following the 2008 food price crisis led in 2010 to the creation of a Working Group on Food Security within the Prime Minister's Science, Engineering and Innovation Council and, in 2012, the National Food Plan green paper (DAFF 2012b), which has seven objectives:

1. Support the global competitiveness and productivity growth of the food supply chain, including through research, science and innovation
2. Reduce barriers that food businesses face in accessing international and domestic markets
3. Contribute to economic prosperity, employment and community wellbeing in regional Australia
4. Identify and mitigate potential risks to Australia's food security

5. Maintain and improve the natural resource base underpinning food production in Australia
6. Reduce barriers to a safe and nutritious food supply that responds to the evolving preferences and needs of all Australians and supports population health
7. Contribute to global food security.

These recommendations will not be easy to implement for a variety of reasons – some local and some global:

- there is significant uncertainty about the proportion of agricultural land owned by foreign governments and corporations, with both left and right-wing sections of the Australian media reporting doubts about the accuracy of a report on this topic produced by the Australian Bureau of Agricultural and Resource Economics & Sciences (see, for example, (Australian Financial Review 2012; Bita 2012; Stagg 2012; Wroe 2012))
- while it is difficult to find reliable statistics, there is growing anecdotal evidence that farmers' children are not choosing to take over the family farm when their parents retire, but instead are moving to the city – a phenomenon by no means restricted to Australia (see, for example, (Armitage 2012; Graber 2012; Stagg 2012))
- Agri-food supply chains are both inefficient (DHL 2012) and, more immediately for the purposes of this research project, do not extend as far as the farm gate (Leat et al. 2011; Sporleder & Boland 2011)
- The technology which supports supply chains is often too complex and/or too expensive for many farmers to access or use (Agrifood Skills Australia 2011). Yet improvements in food safety – especially the advent of traceability, *"the need to trace food consistently and efficiently from the point of origin to the point of consumption"* (Karippacheril et al. 2011) – places primary producers under increasing pressure to adopt a level of ICT sufficient to support participation in agri-food supply chains.

Since primary producers[2], especially the Small and Medium Enterprises (SMEs) which are the focus of this thesis, are the major players in agri-food supply chains (ABS 2012a); food security would not be achievable without their active involvement. The success of an agribusiness is not only determined by production but also by a range of supply chain activities (DAFF 2013b). However, research to date has tended to focus on improving production rather than on agri-food supply chain efficiency. This doctoral research project was designed to identify agri-food supply chain involvement by Tasmanian primary producers and to investigate whether (or how) popular Web 2.0 technologies can enhance SMEs' agri-food supply chain management. The project investigated several sub-sectors related to natural food production: fishery, dairy, fruit, vegetables and livestock.

The remainder of this chapter is organised as follows. Section 1.2 provides the justification for the research project. Section 1.3 defines the scope of the research project. Section 1.4 provides an outline of the research.

1.2 RATIONALE OF THE RESEARCH PROJECT

Agriculture has traditionally been an important industry for Australia, though changes to government support for the sector in recent decades have made it increasingly difficult for primary producers to survive natural and financial disasters (ABC News 2013; Bettles 2013). Despite Australia's huge arable land area, the limited contribution of agriculture to the nation's Gross Domestic Production (GDP) – a mere 2.4% in 2010-2011 (ABS 2012b); as well as the aging farm population – the average age of Australia's primary producers was 53 in 2011 (ABS 2012a) – illustrate the difficulty of enhancing agribusiness to the level needed for Australia truly to become the 'food bowl of Asia'. This is a particular problem for the small and medium enterprises (SMEs) which make up the majority of Australian agri-business and which struggle to survive in an increasingly hostile physical and regulatory environment[3].

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[2] All the primary producers surveyed in this research are the primary decision makers within their family businesses, which are all agri-food SMEs of one sort or another. Farmers form the majority of the primary producers studied for this project, while the remainder are from the seafood sub-sector. The terms 'primary producer', 'farmer' and 'agri-food SME' are used interchangeably in the thesis, unless otherwise specified.

[3] The Australian federal government released the Farm Finance low-interest loan package, providing short-term assistance for struggling farmers, in response to *"acute levels of debt and … depreciation of land values"* (ABC 2013; DAFF 2013a)

The importance (and frequent crises) of the agri-food sector have attracted many researchers but, in general, they have concentrated on topics relating to on-farm technologies (Peterson et al. 2000). Yet the intensive competition and dynamic business environment of today's agricultural sector means that food producers (many of whom are family businesses) must achieve not only on-farm, but also "external" and off-farm efficiencies associated with their supply chain management (Van der Vorst et al. 2007).

The supply chain management concept is well understood in the manufacturing and retail sectors, but is still in its infancy in the agricultural domain (Fowler et al. 2002; Van der Vorst et al. 2007). In addition, despite the significant efforts expended on supply chain management across all sectors, few real-world supply chains have achieved truly satisfactory results for their SME participants – generally because of limited internal resources on the part of the smaller supply chain partners (Chong et al. 2009; Matopoulos et al. 2009) and their lack of suitable web technology (Teng et al. 2012; Tiessen et al. 2001; Vaaland & Heide 2007).

There was a loss of confidence in the Web following the bursting of the Internet Bubble in 1999/2000 (Mills 2002) but the appearance of Web 2.0 in 2004 (O'Reilly 2007) has been a major factor in the re-growth of public and business confidence in Web technology (Treese 2006). Web 2.0, as its name implies, is the next generation web technology (Wienclaw 2008) and is characterised by a number of features: the web as a platform; harnessing collective intelligence; an emphasis on data; perpetual updates; modular applications following for flexible reassembling; substantial platform adaptability; and rich user experiences (O'Reilly 2007).

Web 2.0 was initially best known as the enabler of web-based social software. Over time, however, people have come to see it as a means of promoting the internet economy and innovatively extending its applications to provide a web-based, easy to use, flexible and affordable solution for the business world (He et al. 2007). The most popular Web 2.0 components for business use now include: social networking; collective intelligence; Software-as-a-Service (SaaS); Application Programming Interfaces (API); Asynchronous JavaScript and XML (AJAX); mashups; blogs; podcasts; and tagging (Andersen 2007; DiMicco et al. 2008; Goh et al. 2007; He et al. 2007; Hoegg et al. 2006; Norfolk 2007).

These findings suggest that there may be a role for user-friendly Web 2.0 solutions to assist SMEs in overcoming the internal and external inhibitors they confront in supply chain management (Goh et al. 2007; Ooi et al. 2011) and to enable them to build links with their supply chain partners.

Despite its wide levels of acceptance and its “sexy” image, the application of Web 2.0 to business still lacks a truly solid research base. A number of researchers have a pessimistic attitude to its value and usefulness (Wienclaw 2008) and some even suspect we may be seeing another technology bubble (Best 2006; Treese 2006). Research into the use of Web 2.0 within the agri-food supply chain, in particular, is still in its infancy despite the importance of food production (DAFF 2009, 2013b) and the constant pressure on primary producers to increase their productivity (Mallawaarachchi et al. 2009; Nossal & Gooday 2009).

More research is required into the significance of Web 2.0 for SMEs involved in supply chain management – particularly in terms of how Web 2.0 might assist primary producers (agri-food SMEs) to enhance their supply chain(s) performance. This research project was designed to fill a gap in the existing supply chain management literature – with its focus on manufacturing and retail chains – by investigating the possible role of new technology in enhancing agri-food supply chains.

1.3 SCOPE OF THE RESEARCH

The research project focused on the ICT and, especially, on Web 2.0 applications used by the agri-food SMEs (with emphasis on primary producers) to manage their supply chain activities.

The project was concerned with the Australian experience and, in particular, was based on agricultural practices in Tasmania. The empirical research was undertaken in Tasmania for a variety of reasons: 1) Tasmania is an isolated region and of a manageable size for completing Information and Communications Technology (ICT) adoption research within the limited timeframe offered by a PhD project; 2) despite some minor differences, Tasmania has a similar agri-food system to that of mainland Australia, thus permitting extrapolation of the findings in future research; 3) the agri-food industry is important to the Tasmanian economy (DEDT 2008; DEDTA 2013); and 4) this research focusing on the Tasmanian agri-food industry permits the inclusion of the impact and possible benefit of the National Broadband Network (NBN) which has had its initial roll-out in this State.

Although this project’s findings are indicative, it does not seem unreasonable that they might also be generalised to mainland Australia, where agri-food also plays an important role.

1.4 OUTLINE OF THE THESIS

This thesis consists of eight chapters describing the background, research methodology, empirical work and conclusion of the project. This section summarises the contents of each chapter.

Chapter 2 reviews the literature in four main domains: the evolving agri-food supply chain; agri-food SMEs' supply chain management with a focus on ICT aspects; Web 2.0-enabled supply chain management; and technology acceptance models. The literature review encompasses a body of work regarding 'using web 2.0 to enhance agri-food SMEs supply chain management' and provides the basis for the initial theoretical framework, the 'Rural Web 2.0 Technology Acceptance Model' (RuWebTAM). The overarching research question and six subsidiary research questions (SRQ) are outcomes of the literature review. The results of this chapter also provide an answer for SRQ1 and SRQ2.

Chapter 3 introduces the main research methodologies and methods of the information system domain. It justifies the selection of research methodology employed in the research project.

Chapter 4 summarises and presents the findings obtained from a series of key informant interviews. The supply chain diagrams in each sub-sector included in this chapter were based on the outcomes of the key informant interviews and provide an overview of each supply chain that was investigated in the research project. The outcomes of the key informant interviews answer SRQ3 and SRQ4.

Chapter 5 describes the preparation and overview of the survey. This includes the development of the survey questionnaire, the sampling population, development of the prototype and survey administration.

Chapter 6 describes the findings of the survey, which was the second and principal component of the empirical data gathering. Both quantitative and qualitative data gathered from the survey are analysed in this chapter. The findings provide answers for SRQ3, SRQ4 and SRQ5.

Chapter 7 describes the survey findings, which focus on the effect which the empirical data gathered in the survey had on the determinants and moderators of the RuWebTAM and their interactions. The outcomes illustrate the revised model which emerged from this phase of the research project.

Chapter 8 describes the data validation which was the third and final stage of the empirical study. Focus group, a nominal group technique designed to identify consensus as the outcome of discussion focusing on particular topics, was employed to validate the data gathered from the key informant interviews and from the survey. The focus group findings provided the material necessary to enable finalization of the research model; and this chapter answers SRQ5 and SRQ6.

Chapter 9 concludes the entire thesis, summarises the findings, draws a number of concluding remarks; and sheds some light on possible future research.

Chapter 2

Literature Review

This chapter is based around a publication presented at the International Conference on Internet Technologies & Society (ITS 2012) Perth, Australia (Liao et al. 2012)

2.1 INTRODUCTION

Chapter 1 introduced the thesis. In this chapter, in order to identify the literature gap, a range of relevant literature has been reviewed. To find the answers for the literature gap an overarching research question and six subsidiary research questions have been developed. An initial research model underpinning the research has been developed and is included at the end of this chapter.

This section introduces the agri-food supply chain and its evolution, before moving to the literature relating to primary producers and their existing supply chain practices – especially those related to ICT – and a discussion of the possibilities that Web 2.0 might provide for the agri-food supply chain.

There is a brief coverage of the literature supporting the research questions. The components of this literature review are illustrated in Figure 2-1 which shows how they are inter-linked and the order in which they are discussed.

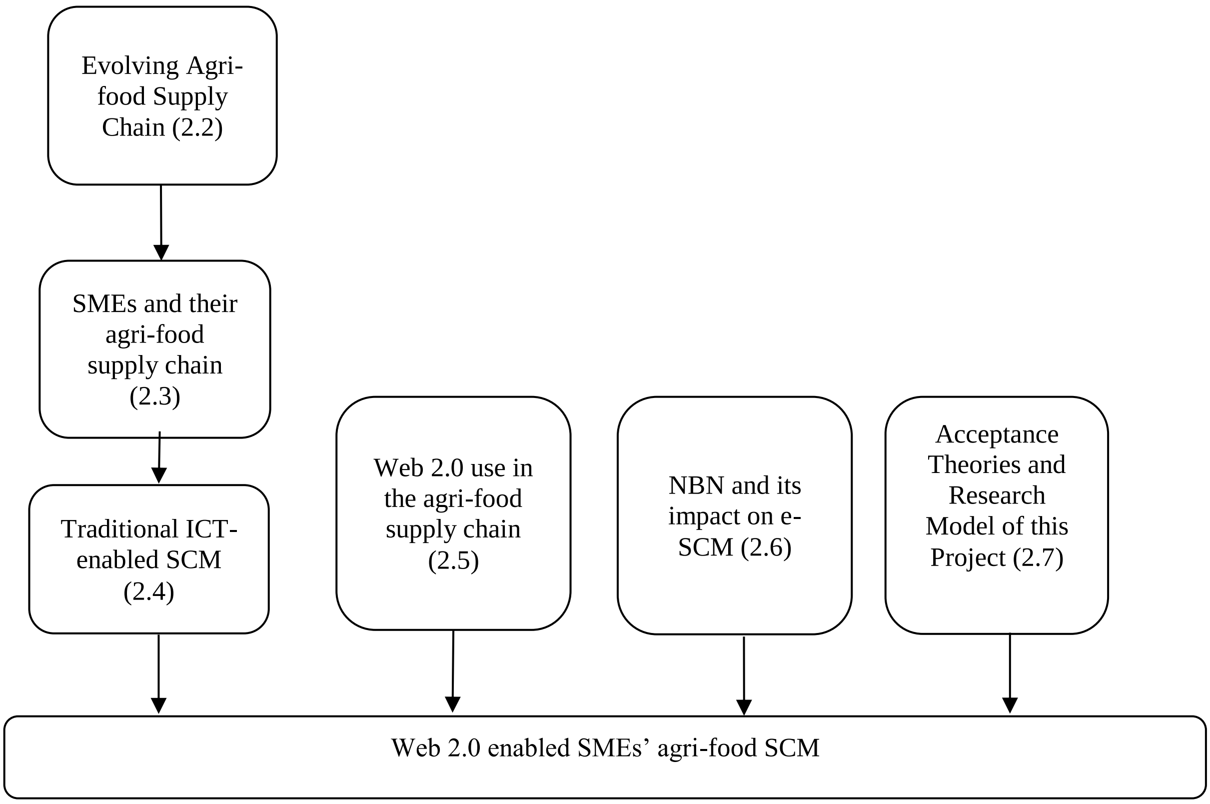

Figure 2-1: Literature Review Structure

The literature review begins with an overview of the evolving agri-food supply chain, which helps to set the scene and identify the problems that exist in the agri-food supply chain in general. After the background knowledge has been introduced, a summary of existing studies concerning SCM use by agricultural SMEs with a focus on the ICT aspect is provided. Once the gaps in the literature have been identified, this chapter then attempts to analyse the concept of Web 2.0, as well as the advantages of Web 2.0-enabled SCM. Finally, there is a brief introduction relating to the National Broadband Network roll-out in Tasmania and its impact on farmers' ICT use before the chapter turns to a review of technology acceptance theories, grounded on an initial research framework which has been developed as a foundation for investigating the research questions.

2.2 THE EVOLVING AGRI-FOOD SUPPLY CHAIN

The term 'supply chain', defined by Mentzer et al. (2001) as *"a set of three or more entities (organizations or individuals) directly involved in the upstream and downstream flows of products, services, finances, and/or information from a source to a customer"* covers a very wide range of production and logistics activities. Despite their general similarities, there are significant differences between agri-food production systems and other manufacturing production systems (Jang & Klein 2011; Sporleder & Boland 2011) due to the former's unique attributes, including seasonality of production, perishability and price fluctuations (Matopoulos et al. 2005; Sporleder & Boland 2011).

Over the past few decades there have also been gradual and significant changes in the agri-food supply chain, which can be characterised as increasing concentration, retailer dominance, globalisation, increasing requirements for traceability, social and environmental concerns, and emerging alternative agri-food networks (AAFNs) (AFGC 2011; Andrée et al. 2010; Burch & Lawrence 2005; Busch & Bain 2004; OECD 2006, pp. 3,11; Richards et al. 2011; Smith et al. 2010; Spencer & Kneebone 2012; Van Der Meer 2006).

Concentration is a very significant change which has occurred in all parts of the agri-food supply chain (Lawrence 1999; Rademakers & McKnight 1998; Salin 1998; Spencer & Kneebone 2012; Van Der Meer 2006) but particularly at the retailer level (Burch & Lawrence 2005; Hanf 2008; Réviron & Chappuis 2005; Richards et al. 2011; Robson & Rawnsley 2001). The issue of concentration is especially relevant in Australia (Clarke 2012) where two chains (Coles and Woolworths) together account for over 60% of all retail food sales (Woodings 2012) and 78% of all supermarket sales (AFGC 2011). Retailers, particularly supermarkets, play a dominant role in contemporary agri-food supply chains (Burch & Goss

1999; Réviron & Chappuis 2005; Richards et al. 2011). Monopoly in distribution allows dominant supermarkets to exercise enormous bargaining power in negotiating with their suppliers (Burch & Lawrence 2005). As a result, a relatively large number of suppliers must accept harsh policies and minimum prices in exchange for contracts offered by a small number of large and powerful retailers (Robson & Rawnsley 2001). The increasing number of own-brand products introduced by large supermarkets can only strengthen their bargaining power and market dominance (AFGC 2011; Burch & Goss 1999; Burch & Lawrence 2005).

Globalisation has affected agri-food supply chains in two ways: firstly, many multinational retailers have entered local supply chains and leveraged their enormous buying power to force local suppliers to accommodate their demands (Moreira 2011; Rademakers & McKnight 1998); and secondly, global sourcing enables retail giants to replace local suppliers with off-shore alternatives, which further strengthens their buying power (Lawrence 1999; Spencer & Kneebone 2012). The recent strong Australian dollar makes prices of local produce less competitive than imported products (AFGC 2011).

Apart from the cost-related changes there are also increasing concerns over non-price issues such as emerging demands for niche market specialty foods and organic products (Lu & Swatman 2009; McDonagh & Commins 1999; Moreira 2011) as well as an increasing demand for more detailed product information concerning quality, safety, traceability, social & environmental sustainability, animal welfare; and ethics (Cebeci et al. 2009; Lehmann et al. 2011; Matopoulos et al. 2005; Ortmann & King 2010; Van Der Meer 2006). Especially in recent years, researchers have shown an increased concern over traceability, which is an important way to control food safety and quality as well as to ensure human health (DAFF 2012b; Teng et al. 2012). The challenges of the traceability issue, however, have been highlighted by a number of incidents worldwide such as the 2009 outbreak of Hepatitis A linked to consumption of semi-dried tomatoes in Australia and the Escherichia coli outbreaks in Europe in 2011 (DAFF 2012b). These issues have had important impacts on consumer food preferences and have led to the increasing popularity of alternative food networks such as farmers' markets, community-supported agriculture and 'boxed food' schemes which enable customers to obtain featured products locally (Smith et al. 2010).

These transformations have created unprecedented challenges and opportunities for agri-food SMEs. In the past, when commodities were in short supply, marketable yield was the main focus of primary producers (O'Keeffe & Fearne 2009). Today, however, when supply is exceeding demand, primary producers are required to develop new capacity to manage their supply chains in an increasingly volatile environment (O'Keeffe & Fearne 2009). In order to identify approaches which might support agri-food SMEs to achieve sustainable supply chains, it is necessary to first understand their features and, more importantly, their existing supply chain practices based on these features.

2.3 SMEs AND THEIR AGRI-FOOD SUPPLY CHAINS

Currently there is no universal definition for Small and Medium Enterprises (SMEs), but most countries have defined a maximum threshold for this group of organisations in terms of number of employees, turnover and total assets. In the U.S., SMEs are defined as firms with fewer than 500 employees (Basefsky & Sweeney 2006). By contrast, the European Commission defines an SME as a company with fewer than 250 employees and either a turnover of no more than €50 million or assets of no more than €43 million (European Commission 2003).

In the Australian agri-food sector, business size is classified by the number of employees (ABS 2005) or the Estimated Value of Agricultural Operations (EVAO) (ABS 2002). Since the EVAO is difficult to estimate, this research project has adopted the number of employees as its measurement of classification. Small and Medium size agri-food businesses are therefore defined as those employing fewer than 99 full time employees (Molla & Peszynski 2011).

Individual firms become a part of a supply chain to enhance their ability to compete with other supply chains (Uddin et al. 2011) as research suggests the agri-food industry is gradually moving from direct competition between companies to a more aggregated form of competition at the supply chain level (de Barcellos et al. 2011; Van Der Meer 2006). Similarly, de Barcellos et al. (2011) found that competition within the agri-food industry has changed from enterprise vs. enterprise to supply chain vs. supply chain. This marks a major shift in emphasis in this sector which can be illustrated by decreasing competition between neighbouring farmers or competing agribusiness producing similar agricultural products, but increased competition between the supply networks dominated by the seed-chemical conglomerates (Leroux et al. 2001). These findings confirm an earlier result reported in Matopoulos, Vlachopoulou and Manthou (2005), who discovered that the growers-packers-exporters chains were competing at a national level. Thus individual firms became part of one supply chain and their inability to collaborate with other supply chain members directly affected the enterprises' competitive competence (Matopoulos et al. 2006).

Additionally, the intensely competitive and dynamic business environment of today's agricultural sector means that food producers (many of which are family businesses and, effectively, SMEs) must achieve not only on-farm efficiencies, but also "external" and off-farm efficiencies, through effective supply chain management (Lehmann et al. 2011; Van der Vorst et al. 2007). The supply chain management concept is well accepted in the manufacturing and retail sectors, but is still in its infancy in the agricultural domain (Jang & Klein 2011; Van der Vorst et al. 2007). Agri-food supply chain management, with its unique characteristics, has developed as a research discipline (Bourlakis & Weightman 2004, p 1). Since SCM for SMEs differs from its equivalent in large enterprises (LEs) in a number of ways (Arend & Wisner 2005; Vaaland & Heide 2007), it is necessary to consider SME agri-food supply chain management by taking SME features into account.

2.3.1 CHALLENGES FACED BY SMES IN SUPPLY CHAINS

Agri-food SMEs, mostly family farms due to their small size, have very limited resources in terms of personnel, finance and variety of knowledge types related to management, marketing, commercialisation and information technology (Brush & McIntosh 2010; Molla & Peszynski 2009; Simmons et al. 2007). However, they also have advantages in terms of their agility and of their more motivated self-employed farmers (Simmons et al. 2007; Van Der Meer 2006). Family farmers who consider farming a way of life may well have stronger motivation to adopt environmentally friendly and healthy ways of raising crops and animals than do larger agri-businesses (Wender 2011). In competition with the industrial and large scale farming operated by large corporations (Trevors & Saier 2010), family farms are disadvantaged by their significantly smaller production and higher input costs (Wender 2011). As a result, they may face a number of challenges in their supply chains and, more importantly, in managing their supply chains.

Challenges existing in agri-food supply chains are diverse and comprehensive and may include: distribution network configuration, distribution strategy, information management, inventory management and cash flow (Adhikary & Achary 2012). For the sake of clarity, these challenges are grouped into two categories: information management and distribution channel.

2.3.1.1 INFORMATION MANAGEMENT

Information and effective information management are important for SMEs in the agri-food sector (Matopoulos et al. 2004).

Farmers have traditionally been challenged by uncertainty and lack of information of all kinds, from weather and farm management to market prices (Mittal 2012). Without farm information, farmers can only make decisions by vague estimates and guessing based on their past experience (Johl & Kapur 2001) and agri-food SMEs are therefore unlikely to achieve satisfactory outcomes in today’s competitive agri-food industry (Tham-Agyekum et al. 2010). Lack of information not only influences small producers’ production but also their business outcomes as they are unable to access a wide range of supply channels and are placed in a weak position in fluctuating commodity markets (Adegbidi et al. 2012).

The ultimate outcome of information depends on a farmer’s ability to manage information flows (Mittal 2012). It is suggested that the effects of these challenges can be lessened or minimised by obtaining high quality and up-to-date information and using it effectively (Mittal 2012). However, effective information management in the agri-food industry, despite its importance, has long been challenged by lack of standardised information, lack of integrated systems (Bunte et al. 2009) and the entities’ inability and reluctance to share information (Matopoulos et al. 2004). Specific characteristics of the agri-food industry are also believed to be an obstacle for the information management (Brewster et al. 2012). These include complexity of products and process, diversification of small agribusnesses and lack of appropirate mechamism to support transpareny (Brewster et al. 2012).

2.3.1.2 DISTRIBUTION CHANNEL

Agri-food SMEs have access to limited distribution channels which also contributes to the increasing concentration and dominance of large retailers (Burch & Lawrence 2005; Woodings 2012). McDonagh & Commins (1999) summarised two options for agri-food SMEs: incorporating into large, global retailer-dominated supply chains, or adapting to local and self-controlled supply chains. In a study of small-scale farmers in South Africa, Louw (2008) compared and listed the marketing channels available for to these farmers in order of ease-of-entry as: informal markets, greengrocers, national food produce markets, agro-processors, and supermarkets. Although these general difficulties are faced by all producers, agri-food SMEs may also encounter special challenges in their supply chain management in particular market categories.

Evidence suggests that it is not only difficult for agri-food SMEs to join large retailer-dominated supply chains (Louw et al. 2008) but that, when these SMEs do manage (or are forced) to join such supply chains, they find the experience difficult and unrewarding (Burch & Goss 1999; Lawrence 1999; Moreira 2011; Ortmann & King 2010; Rademakers & McKnight 1998). For example, agri-food SMEs are required to supply high-quality produce at the lowest possible price and wait for long periods to receive payment, which can be extremely difficult for small companies (McDonagh & Commins 1999; Moreira 2011; Robson & Rawnsley 2001). Small producers are also increasingly being excluded from supermarket chains and replaced by larger producers who can fulfil the supermarkets' particular requirements (Louw et al. 2008).

Alternatively agri-food SMEs can choose to align themselves with a local and self-controlled supply chain (McDonagh & Commins 1999). Avoiding large retailer-dominated supply chains and adapting to local supply chains may permit SMEs to have more control on their business operations, even though it requires more effort in terms of supply chain management on their part for activities such as marketing and distribution.

2.4 TRADITIONAL ICTS IN AGRI-FOOD SUPPLY CHAIN

There are a significant number of published studies describing the role of ICT in overcoming the challenges of information management and distribution channels encountered in the agriculture industry (Adegbidi et al. 2012; Glendenning & Ficarelli 2011; Marantidou et al. 2011; Nazarpour et al. 2011). Today's complex supply chains rely heavily on the support of ICT (Gunasekaran & Ngai 2004; Trienekens et al. 2012) and ICT generally influences the market concentration, transaction cost and market transparency of the food industry and food supply chain (Bunte et al. 2009). It is therefore necessary to examine the role ICT plays in the agri-food supply chain management from the SME's perspective.

In practice, the agri-food supply chain has become far more complicated than a linear connection between buyer and seller, with the participating organisations in both vertical and horizontal dimensions increasingly constituting an agri-food supply ***network*** (Bourlakis & Weightman 2004, ix; Hanf 2008; Lehmann et al. 2011, p. 13; Van der Vorst et al. 2007), as shown in Figure 2-2.

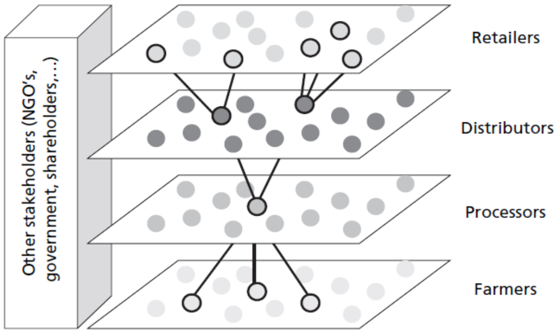

Figure 2-2: The agri-food Supply (chain) Network
(Van der Vorst et al. 2007)

In a modern agri-food supply chain, it can be difficult to identify the original source of individual products after they have been processed and reconfigured by a number of physically distant individuals or companies in both the primary produce industry as well as in food technology, chemistry and biotechnology (Richards et al. 2011). Traditional paper-based management is simply not capable of dealing with the complexities of network-based inter-relationships – and, while all supply chain management relies on the usefulness and effectiveness of information technology, this is a major challenge for SMEs with their limited financial, personnel and knowledge resources (Brush & McIntosh 2010; Jutla et al. 2002; Vaaland & Heide 2007).

The increasingly complicated structure of the agri-food supply chain itself is a motive for investigating ICT support for such supply chains. Moreover the collaboration and management of a modern supply chain would be impossible without the use of a suitable ICT solution, and therefore many authors have extensively investigated the use of ICT in enhancing supply chain management (Matopoulos et al. 2009). ICT use in agri-food supply chains can, in general, be characterised as low complexity and low adoption rate (Gelb & Voet 2009; Manthou et al. 2005).

2.4.1 ICT COMPLEXITY

The use of ICT in agri-food is not yet very complex (Manthou et al. 2005). Lockett & Brown (2001) have classified the complexity of e-business applications and this is shown in Table 2-1: Classification of e-Business application complexity. Its use is still at an early stage in the agri-food industry, even in developed countries, and at this stage ICT is mainly restricted to email and a web presence within this market sector (Bhaskaran & Gligorovska 2009; Manthou et al. 2005).

Table 2-1: Classification of e-Business application complexity (Lockett & Brown 2001)

Classification	Examples	Complexity
Communication	E-Mail, Web Access	Very Low
Marketing	Web site	Low
Productivity	MS Office, Intranet	Low
e-Commerce	Buying & Selling On-line	Medium
Collaborative	Extranet	Medium
Enterprise	Financials, Vertical Applications	High
Marketplace	e-marketplaces	High
Collaborative Enterprise	eSCM, eCRM	Very High
Collaborative platform	Emerging Platforms	Very High

EDI was an important enabler for supply chain integration in the past but its high cost is an intrinsic drawback for agri-food SMEs considering adoption (Manthou et al. 2005). Difficulties in implementation and limitations in real time data sharing are suggested as reasons for EDI's unpopularity among SMEs (Ooi et al. 2011).

The e-marketplace is a higher level of ICT use (Lockett & Brown 2001) and has the potential to improve supply chain performance (Grieger 2003; Movahedi et al. 2007). Matchmaking is a prominent role played by the e-marketplace (Dumas et al. 2004; Fong et al. 1997) and it provides additional market channels for participants to reach broader customer and supplier bases, resulting in a reduction of both transaction and middleman costs (Brush & McIntosh 2010; Fong et al. 1997; Manouselis et al. 2009). It is possible to extend the function of an e-marketplace to enable supply chain management but this may require specialised programmers to develop customised features to suit clients' specific SCM requirements (Manouselis et al. 2009). Moreover, lack of a social networking function, considered to be a critical part of the farming community, has been criticised as a serious drawback of the agri-food e-marketplace (Cloete & Doens 2008; Driedonks et al. 2005; Fong et al. 1997).

With the advent and popularity of smartphones - mobile devices able to provide mobility, seamless Internet access and compact functions - are considered as suitable platforms for primary producers to manage their supply chains (Lu & Swatman 2009; Manouselis et al. 2009). Smart phones open a door for primary producers previously making little use of computers and the Internet to embark on ICT training and, more importantly, to apply ICT to their SCM. According to Google CEO Larry Page:

> *"Many users coming online today may never use a desktop machine, and the impact of that transition will be profound"* (Waugh 2012).

Research and development of more compound e-platforms facilitating SCM have been proposed (Holt et al. 2007; Verloop et al. 2009; Wolfert et al. 2010; Wolfert et al. 2007). Holt et al. (2007) in the research agenda for SMEs in electronic platforms for the European food industry oriented the future research to examine how SMEs can incorporate e-traceability and supply chain management into their existing business process. Chrysochou, Chryssochoidis & Kehagia (2009) also argued that in agri-food supply chains there is an increasing demand for the implementation of traceability systems, as traceability is gradually becoming a mandatory requirement in the industry. Compared to paper-based traceability systems, IT-enabled traceability systems are recognised as an evolution improving efficiency, and effectiveness (Chrysochou et al. 2009). To improve food safety and quality e-MENSA (e-platform Technologies for the European Agro-food Supply Chain), a solution designed to develop collaborative agri-food supply chain infrastructures in Europe, has had satisfactory outcomes but mainly for large firms (Tecnoalimenti 2011). The Agri-food Living Lab is designed to facilitate information exchange and innovation by harnessing the collective intelligence of a range of parties such as agri-food business & government, research & education and ICT consultancies in the agri-Food Supply Chain Network (AFSCN) (Wolfert et al. 2010), but it encountered significant difficulty in attracting a critical mass (Wolfert et al. 2010).

Differences also exist in the use of ICT within the larger-size firms versus SMEs. Manthou, Matopoulos and Vlachopoulou (2005) found that larger companies have implemented sophisticated e-business applications, while the majority of SMEs considered ICT as just another communication tool. Matopoulos, Vlachopoulou & Manthou (2009) believed this might well be due to the differing complexity of supply chain operations at the two levels and the reluctance of SMEs to change their way of doing business.

2.4.2 ICT ADOPTION

Since applying ICT to agri-food supply chains comes under the umbrella of ICT adoption in the agri-food industry and there is little literature specifically investigating the adoption of ICT-enabled supply chain management, this section reviews the literature concerning both ICT adoption in agri-food supply chains specifically as well as its adoption in the agri-food industry more generally.

The reasons for ICT adoption in the agri-food industry have attracted significant attention and a variety of factors influencing adoption have been identified (Brush & McIntosh 2010; Gelb & Voet 2009; Matopoulos, Vlachopoulou & Manthou 2007; Molla & Peszynski 2011; Simmons et al. 2007). The influencing factors are classified into different dimensions, including: facilitators and inhibitors (Zhu et al. 2003); industry, company and external environment dimensions (Gregor et al. 2002); internal characteristics of the firm, vertical network relationships, and characteristics of the environment dimensions (Galliano & Orozco 2011); e-business application, intra-firm related and supply chain level dimensions (Matopoulos, Vlachopoulou & Manthou 2007; Matopoulos et al. 2009); and organizational, technological and external environment dimensions (Brush & McIntosh 2010).

Four dimensions (motives, inhibitors, intrinsic and extrinsic dimensions) have been identified as commonly agreed factors in investigating ICT adoption. The benefits reaped from ICT adoption are also considered to be motives for future adoption and, therefore, the benefits cited by the literature will be integrated into the motives category which will be renamed ‘motives and benefits’. The following discussion employs an integrated approach to reviewing the literature. In particular, the influencing factors will be categorized as motives and benefits, or as inhibitors; and these factors will be further subdivided into intrinsic and extrinsic dimensions. Intrinsic factors include: resource availability, management opinions; and support (Brush & McIntosh 2010; Gregor et al. 2002; Matopoulos et al. 2009), while extrinsic dimensions include: infrastructure adequacy, regulatory influences, market pressure, relationship among supply chain members, supply chain complexity; and e-business compatibility (Brush & McIntosh 2010; Gregor et al. 2002; Matopoulos et al. 2009).

2.4.2.1 MOTIVES AND BENEFITS

There are a number of motives driving agricultural SMEs to adopt ICT. These motives can be sorted into intrinsic and extrinsic factors. The intrinsic factors include better information management, better communication quality, knowledge sharing, time saving and cost saving, improved marketing performance, and better collaboration. The extrinsic motives include competition and industry requirements.

The most significant advantage of ICT is the improvement to information and communication services it provides (Marantidou et al. 2011) which enables collaboration along the supply chain. ICT is an enabler for farmers to access information and that information, especially context-specific content, has critical impacts on farm outcomes (Glendenning & Ficarelli 2011). Lu and Swatman (2009) investigated the possible benefits of mobile certification technology to the organic farming sector and found that by using such technology, primary producers could achieve better record keeping, as well as more efficient communication and information exchange (Lu & Swatman 2009).

Closely related to information and communication improvement, use of ICT also allows knowledge creation and sharing (Barba-Sanchez et al. 2007). ICT connects farmers with their community and makes it possible for them to share information and brainstorm (Glendenning & Ficarelli 2011). Utility of knowledge is an increasingly important factor for the marginal farmers to improve their business operation (Glendenning & Ficarelli 2011). Investigating the use of ICT in small scale agriculture in Africa, Munyua et al. (2009) believe ICT is playing an increasingly important role in improving SMEs' information and knowledge sharing. These findings suggest that the motives and perceived benefits of using ICT have evolved from passive means such as information gathering (Manthou et al. 2005) and access, to online services (Rolfe et al. 2003); and finally to active engagement such as information sharing and social networking (Burke 2010).

ICT not only plays an important role in SMEs' information and knowledge management but also contributes to cost and time saving (Barba-Sanchez et al. 2007). Brush and McIntosh (2010) believe that the adoption of a livestock marketplace helps reduce transaction costs and helps to avoid agents' commission. In contrast, when investigating internet-based applications in the canning sector of the agri-food supply chain in Greece, Manthou et al. (2005) found that motives came from external factors such as customer service and competition, rather than from internal factors such as time saving and internal efficiency improvement.

There are significant differences between benefits experienced by large enterprises and those of SMEs. In their study of eight large agribusiness, Matopoulos et al. (2009) found cycle time reduction and quality improvements, rather than cost savings, are the main impacts of e-business implementation. Although it is sometimes difficult to specify benefits, Barba-Sanchez et al. (2007) point to the importance of benefits gained from ICT adoption over its investment and maintenance cost.

ICT is considered a useful marketing and process management tool in the agri-food industry (Adegbidi et al. 2012). This confirms the finding of Munyua et al. (2009) that ICT is playing an increasingly important role in enhancing SMEs' marketing performance. Focusing on micro enterprises, Brush & McIntosh (2010) interviewed 11 micro agribusiness in New Zealand to investigate their motivation for, and inhibitors to, adoption of the Live.ex livestock e-marketplace. Their findings indicated that improvement of market reach and more control over the transaction and information were dominant motivations of their adoption (Brush & McIntosh 2010). Bhaskaran and Gligorovska (2009) also believe that ICT can expand SMEs' market reach and change the landscape where agri-food SMEs are operating.

Apart from internal motives, many researchers have found that external factors also play an important role in determining ICT adoption (Matopoulos et al. 2009). Competition, increasing operational complexity, increasing levels of collaboration and customer service needs appear to be the common motives for ICT adoption in the agri-food industry (Manthou et al. 2005; Matopoulos, Vlachopoulou & Manthou 2007; Matopoulos et al. 2009).

ICT is considered an enabler for SMEs to collaborate in supply chains (Barba-Sanchez et al. 2007). This finding was confirmed by Lu and Swatman (2009) who discovered that the mobile platform allows organic farmers to better integrate into the agri-food supply chain; and by Lehmann (2011), who found that a collaborative supply chain plays an important role in achieving satisfactory information exchange in the supply network. In order to overcome challenges encountered in their supply chains, it is necessary for agri-food SMEs to consider some form of collaboration (Jang & Klein 2011; Jutla et al. 2002; Matopoulos, Vlachopoulou, Manthou, et al. 2007; Pickernell et al. 2004; Takeno et al. 2008). Given the importance of collaboration in the ICT-enabled supply chain, the literature explicitly concerning collaboration for SMEs will be discussed.

There are several forms of collaboration for agri-food SMEs. Matopoulos, Vlachopoulou and Manthou (2005) introduced the concept of clusters, a particular form of collaboration, to the agri-food industry. The research examined the business potential of such clusters which is defined by Porter (1998) as *"geographic concentrations of interconnected companies and institutions in a particular field"*. The significant strength of clusters for SMEs is that it allows each agribusiness member to take advantage of greater scale, akin to joining with others officially, while retaining their flexibility (Porter 1998).

However, it is difficult to achieve collaboration in agri-food supply chains (Matopoulos, Vlachopoulou, Manthou, et al. 2007) and collaboration is affected by a number of unique features of the industry (Matopoulos et al. 2005, 2006; Matopoulos, Vlachopoulou, Manthou, et al. 2007; Pickernell et al. 2004).

The collaboration in agri-food supply chains is influenced by both macro factors (i.e. the external environment of the sector), as well as micro factors (i.e. the industry's structure and product features). Matopoulos, Vlachopoulou and Manthou (2006) identified: the entrance of new global competitors; industry consolidation; alternative distribution opportunities; and the evolution of technology as the likely macro factors stimulating collaboration in the agri-food supply chain. Matopoulos, Vlachopoulou, Manthou and Manos (2007), however, conducted a case study of the grower-processor interface which found that not all macro-factors enhanced the intensity of collaboration. Changing consumer attitudes did enhance intensity of collaboration, but globalisation and stricter laws / regulations regarding food production do not have an obvious impact on collaboration intensity. In terms of micro-factors, the case study findings suggested that many of the barriers to collaboration are a result of the complex and heterogeneous structure of the agri-food industry, as well as the nature of the products sold. Moreover low levels of trust, unfair benefit share and instable policy are believed to be undermining inhibitors influencing collaboration (Taylor 2005).

In an extension of earlier work, Matopoulos, Vlachopoulou & Manthou (2006) also analysed and compared four types of business activities – individual operation, chains, networks and clusters. Their findings indicated that SMEs should choose their collaborative activities on the basis of the distinctive characteristics of the individual and where their business is in relation to the sub-sector.

These findings suggest that SMEs can reap benefits by joining some form of collaboration. Moreover, the employment of clusters including geographically concentrated companies and institutes in a particular field (Porter 1998) could potentially help the farmers to overcome the difficulties faced in conventional supply chain collaboration, where win-win outcomes among the supply chain members are difficult to achieve (Burch & Lawrence 2007, p76-80). Though many researchers have addressed the importance of collaboration for agri-food SMEs, and even proposed some possible solutions for the collaboration, there is a need for ICT to make the collaboration become reality (Fischer et al. 2008).

2.4.2.2 INHIBITORS

Despite all these advantages, low levels of ICT adoption have attracted considerable research interest, focusing on the obstacles of applying ICT to the agriculture industry (Gelb & Voet 2009), which can be further categorised into intrinsic and extrinsic factors. The intrinsic factors preventing agri-food SMEs from adopting ICT include limited resources, unwillingness to change ways of doing business, uncertain benefits, security concerns and lack of relevant skills in applying ICT to their operations.

Many agri-food SMEs lack resources, which is a barrier against adopting ICT (Molla & Peszynski 2011). Expensive hardware and software and other relevant ICT investments are the main concerns for agri-food SMEs (Manthou et al. 2005; Warren 2004). Moreover, their adoption is challenged by lack of human resources such as staff with sufficient IT skills and IT technician support (Brush & McIntosh 2010). As a result, the application of e-business aiming to improve business performance is disadvantaged by the high cost and difficult implementation (Hinson 2005). By conducting in-depth interviews with eight medium and large companies in the Greek agri-food industry, Matopoulos, Vlachopoulou and Manthou (2009) found that many firms operating in the agri-food industry are SMEs with limited resources. Their reluctance to adopt e-business is one of the most significant reasons for a low e-business adoption rate in the agricultural industry. This finding confirms earlier work by Manthou, Matopoulos and Vlachopoulou (2005) which suggest that the European food industry has been a follower of internet-based applications, mainly because of its dependence on SMEs with little technical sophistication which play a prominent role in the industry.

By contrast, however, some other researchers do not share this belief that limited resources are a critical inhibitor for ICT adoption. Matopoulos, Vlachopoulou & Manthou (2009) believe limited financial and human resources are only excuses for small enterprises to retain business practices rather than applying e-business. Similarly, Driedonks et al. (2005) took economic and social factors into consideration in studying the adoption of e-marketplaces. The case study of an e-marketplace in the Australian beef industry - AuctionsPlus - was employed as the research method to investigate the economic and social factors that may influence e-marketplace adoption (Driedonks et al. 2005). The findings indicated that an unwillingness for making change to an existing social system, rather than economic factors, is the predictor of the adoption (Driedonks et al. 2005). Similarly, Bhaskaran and Gligorovska (2009) used mail questionnaire to survey 498 farmers and argue that the limited use of more sophisticated ICT is not due to resource constraints.

Matopoulos, Vlachopoulou & Manthou (2009) also found a very different situation in larger companies where operational compatibility and level of integration are two determinants for e-business adoption, rather than a matter of resources.

Although there is debate about whether limited resources are barriers for SMEs to adopt ICT, return on investment is clearly an important concern (Bhaskaran & Gligorovska 2009; Gregor et al. 2002). Farmers are generally characterised as conservative and cautious with new technology (Gregor et al. 2002). Molla and Peszynsky (2009) suggested that farmers are reluctant to adopt ICT if they cannot see concrete benefits such as return on investment and efficiency improvement. Primary producers are so busy with farming activities that they may not have sufficient time to explore the benefits available through ICT (Molla & Peszynski 2011). In addition, challenged by insufficient ICT skills (Brush & McIntosh 2010) and lack of marketing skills (Simmons et al. 2007), primary producers may not favor ICT and are unlikely to realise its benefits. Lack of understanding of ICT may possibly raise security concerns which can be another barrier for SMEs wishing to become involved in e-business (Manthou et al. 2005).

ICT adoption is not only affected by internal inhibitors but also influenced by extrinsic barriers (Manthou et al. 2005; Matopoulos et al. 2009). These barriers can be summarised as poor telecommunication infrastructure, incompetent ICT technology, lack of policy support, lack of external requirements, particular features of the sector and the nature of the product.

Although internet access is widespread globally, adequate service is still challenged by poor telecommunication infrastructure in rural and remote areas (Howarth 2012; Lu & Swatman 2009). Inadequate and unreliable Internet service has been widely cited as a significant barrier for agri-food SMEs (who are normally based in rural and remote areas) in adoption of ICT (Brush & McIntosh 2010; Lu & Swatman 2009; Munyua et al. 2009; Warren 2004).

Closely related to telecommunication infrastructure, limitation of ICT applications, and the gaps of the ICT requirement between various users have also been mentioned as obstacles to wide adoption of ICT (Davidson & Cooper 2005; Gelb & Voet 2009). The low adoption is attributed to high cost and the lack of integration capability in the closed propriotory solutions (Brewster et al. 2012). There are a range of firms of varying sizes and diversified ICT demands across a wide range of sub sectors in agri-food supply chains. Lack of tailored applications designed to suit their specific ICT needs may be a reason for limited ICT applications (Gelb & Voet 2009). In particular, in their study of the adoption of an agricultural e-marketplace, Brush and McIntosh (2010) identified some weaknesses of e-marketplaces such as inability to eliminate redundant and outdated information and lack of value-added services such as financial services (Brush & McIntosh 2010). In addition, some intrinsic disadvantages of faceless business, such as lack of social interaction and inability to touch and assess, have also been identified (Brush & McIntosh 2010).

The limitation of ICT applications for agribusinesses is related to two types of issue. First there is the complexity of agricultural products (Brewster et al. 2012; Gelb & Voet 2009; Leroux et al. 2001; Matopoulos, Vlachopoulou & Manthou 2007) and then there is the complexity of social systems in agri-food supply chains (Driedonks et al. 2005; Leroux et al. 2001). There is a wide range of agricultural commodities and products, and these are generally less uniform than manufactured goods (Leroux et al. 2001). In addition to the seasonal and perishable nature of agricultural products (Bertoni et al. 2007; Collins & Sun 2009; Salin 1998), differing grades, producing location, quantities and many other factors lead to difficulties in describing and measuring agricultural products in a consistent manner (Leroux et al. 2001).

In the agriculture sector, the primary producers' way of doing business is related to their social networks, social lives (Driedonks et al. 2005) and personal relationships. In particular, it relates to whom they trust, which is important for doing business (Canavari et al. 2010; Leroux et al. 2001). However, development and maintenance of personal relationships is difficult to achieve in ICT-enabled businesses where face-to-face interaction is absent (Porter 2001). By investigating the adoption of AuctionsPlus – an e-marketplace in the Australian beef industry – Driedonks (2005) found that, since traditional sale yard auctions are an important part of cattle farmers' social lives, the low adoption rate of the e-marketplace can be explained by reluctance to lose their social network. This is also related to their dependence on their agents who, in their social and business networks, play an important role in facilitating their transactions and offer a range of additional value, such as payment protection, product assessment, field knowledge and constant procurement (Brush & McIntosh 2010). It is inevitable that the adoption of e-marketplaces would impact on the agents. Potential conflict with existing working relationships with stock agents may therefore lead to resistance from the agents (Brush & McIntosh 2010; Driedonks et al. 2005). As a result, this kind of ICT solution becomes less favorable for the industry and cannot attract critical mass to allow wide adoption and sustain ongoing usage (Driedonks et al. 2005; Manouselis et al. 2009). Lack of adoption, or at least the low pace of adoption of ICT, is related to lack of critical mass and creates a "chicken and egg cycle" in which potential users do not intend to be the first mover and would not follow until the majority of those in their sub-sector have adopted ICT (Driedonks et al. 2005).

Like the "chicken and egg cycle" mentioned above, ICT adoption is related not only to issues at the organisational level but also to factors at industry or supply chain and government level (Bhaskaran & Gligorovska 2009; Galliano & Orozco 2011; Gregor et al. 2002; Molla & Peszynski 2011). Industry structure, the overall attitude in the industry and e-readiness are also believed to be influencing factors for ICT adoption (Cloete & Doens 2008; Leroux et al. 2001; Molla & Peszynski 2011; Simmons et al. 2007). Similarly Bhaskaran and Gligorovska (2009) suggest the study of novel adoption should go beyond the organizational level, and extend to trading partners' capability and industry context. Leroux (2001) found that ICT adoption is affected by the industry structure; in particular, the increasing consolidation of the industry has a negative impact on ICT adoption in the agriculture industry. This is confirmed by a study investigating agri-food SMEs' ICT adoption in Australia, which found that the dominance of two large supermarket affects SMEs' ICT strategies (Bhaskaran & Gligorovska 2009). Cloete and Doens (2008) believe restricted regulation in some particular agricultural sectors, such as dairy, is a major reason for the low adoption of e-marketplaces. Simmons et al. (2007) point out that the negative attitude of the industry is also an inhibitor preventing ICT adoption. Firms in the industry have little initiative to adopt ICT without a strong market force (Molla & Peszynski 2009).

As an extension of their previous work, Molla & Peszynski (2011) investigated ICT adoption by agricultural firms from e-readiness perspectives. This is categorized as organisational, value-network and institutional e-readiness, which refer to a firm, the firm's trading partners and competitors, and government, professional and industry associations respectively (Molla & Peszynski 2011). Drawing from the outcome of a survey of the Australian horticulture supply chain, it was found that horticulture firms demonstrate relatively good organizational preparation for the conduct of e-business. However, there is a weaker profile of value network e-readiness referring to managers' perception of the e-readiness of suppliers and customers where they operate, and the weakest profiles of institutional e-readiness referring to government, association and industry supports were obtained (Molla & Peszynski 2011). Similarly, Munyua et al. (2009) believe that inappropriate ICT policies addressing rural development is an inhibitor for ICT adoption in rural and remote areas, and more government support is believed to be important if there is to be any improvement (Molla & Peszynski 2011).

2.4.2.3 MODERATOR OF THE MOTIVES AND OBSTACLES

Apart from factors determining adoption, there is a large volume of published studies describing factors which can be considered elements that moderate the determinants. These include: sector (Cloete & Doens 2008); crop types (Burke 2010); firm size (Burke 2010; Manthou et al. 2005; Molla & Peszynski 2009; Molla & Peszynski 2011); involvement of international trade (Molla & Peszynski 2009; Molla & Peszynski 2011); technology experience (Brush & McIntosh 2010; Gregor et al. 2002); business owners' education levels (Burke 2010); business owners' ICT literacy; and gender (Ragasa 2012; Stewart 2004a).

There are also differing opinions among adopters and non-adopters regarding the motivation and inhibitors in adopting the agri-food e-marketplace. In particular, non-adopters may have more perceived inhibitors and less motivation than adopters (Brush & McIntosh 2010).

The adoption of ICT in the agri-food industry is not only complicated but also dynamic. Based on questionnaires collected from five European Federation for Information Technology in Agriculture, Food and the Environment (EFITA) Conference participants since 1999, Gelb and Voet (2009) summarised the opinions in Table 2-2 regarding the inhibitors of ICT adoption by farmers.

Table 2-2: What the factors limit the use of ICT by farmers? (Gelb & Voet 2009)

	Bonn 1999 (%)	Mont. 2001 (%)	Debrecen 2003 (%)	Villa Real 2005 (%)	Glasgow 2007 (%)
Inability of farmers to use ICT	29.3	3.0	34.6	45.0	12.5
Unperceived economic or other benefits	27.6	27.6	21.2	23.3	21.4
Lack of technological Infrastructure	18.9	6.0	23.1	35.0	28.6
Cost of technology	17.6	32.3	25.0	25.0	23.2
Not enough time to spend on technology	12.1	16.9	19.2	10.2	23.2
Do not understand the value of ICT	8.6	16.9	26.9	30.0	17.9
Lack of training	8.6	20.0	19.2	16.7	17.9

The results of these surveys reflect the evolving opinion regarding ICT adoption in the agri-food industry and the fact that there is a need to investigate the current state of ICT adoption in the agri-food industry.

In this information era, ICT has demonstrated its importance in many fields; however, there is a significant shortage of Information Systems applications to meet the information demand of various supply chain participants (Spencer & Kneebone 2012). Much research is focused on on-farm technology such as food nutrition, biotechnology and precision farming. This is also the case in Australia, where the agri-food sector is very important for the nation (Agrifood Skills Australia 2011; DAFF 2012a). There are only a few research projects focusing on ICT use in enhancing Australia’s agri-food supply chain performance (Bertoni et al. 2007; Bryceson 2003a, 2003b, 2006, 2011; Bryceson & Slaughter 2009; Bryceson & Smith 2008; Burch & Lawrence 2005; Gregor et al. 2002; Issar et al. 2004; Jie et al. 2007; Lu 2007; Lu & Swatman 2009; Mackrell et al. 2009; Molla & Peszynski 2009; Molla et al. 2011; O’Keeffe 1998; Pearson & Bailey 2009; Smith et al. 2010). More importantly, there is little research investigating the application of Web 2.0 to the agri-food supply chain in the Australian context. The importance of Australia’s agri-food sector and the lack of research mean that there is a necessity to conduct more investigation in this field.

When specifically considering the SMEs and primary producers in the agri-food supply chain, there is widespread agreement that supply chain members at the beginning of the agri-food supply chain are important to ensure food safety (Lehmann et al. 2011). However, no practical ICT solution for solving the difficulties of the agri-food SCM encountered by SMEs, especially primary producers at the very beginning of agri-food supply chains has (as yet) been developed (Holt et al. 2007). Their findings concerning the barriers faced by SMEs wishing to participate in the agri-food supply chain do, however, suggest, that with the advent of the smartphone, prevalence of social technologies and the roll-out of NBN in Australia, there may be a role for user-friendly Web 2.0 solutions to assist SMEs – and in particular primary producers – in overcoming the internal and external inhibitors they face in supply chain management (Goh et al. 2007), in linking with their supply chain partners, or in engaging in suitable clusters.

The complex management which takes place in the supply chain network requires not only ICT investment but also appropriate use of the right technology. In particular, digitally-enabled integration ability, managerial skills and partner support have been identified as important factors in the development of truly effective supply chain integration (Dong et al. 2009). How to successfully manage these aspects is a puzzle for agri-food enterprises which engage in agri-food supply network management. Whether Web 2.0 can assist agri-food SMEs to achieve these goals is the purpose of this research project.

2.5 WEB 2.0 IN THE AGRI-FOOD SUPPLY CHAIN

There was a loss of confidence in the Web following the bursting of the Internet Bubble in 1999/2000 (Mills 2002), but the appearance of Web 2.0 in 2004 (O'Reilly 2007) has been a major factor in regaining public and business confidence in Web technology (Treese 2006). Web 2.0, as the name implies, is the next generation web technology (Boyles 2011; Wienclaw 2008) and is characterised by a number of features: the web as a platform, harnessing collective intelligence, an emphasis on data, perpetual update, modular applications allowing for flexible reassembling, substantial platform adaptability, and rich user experiences (O'Reilly 2007).

Web 2.0 was initially best known as the enabler of web-based social software. Over time, however, people have come to expect it to promote the internet economy and innovatively extend its applications to provide a web-based, easy to use, flexible and affordable solution for the business world (He et al. 2007). The most popular Web 2.0 components for business use now include: social networking, collective intelligence, Software-as-a-Service (SaaS), Application Programming Interfaces (API), Asynchronous JavaScript and XML (AJAX), mashups, blogs, podcasts and tagging (Andersen 2007; DiMicco et al. 2008; Goh et al. 2007; He et al. 2007; Hoegg et al. 2006; Norfolk 2007).

These findings suggest there may be a role for user-friendly Web 2.0 solutions to assist SMEs to overcome the internal and external inhibitors they confront in supply chain management (Goh et al. 2007) and to enhance links with their supply chain partners.

Despite its wide levels of acceptance and its ‘sexy’ image, the application of Web 2.0 to business, especially small size businesses still lacks a truly solid research base (Boyles 2011). A number of researchers have a pessimistic attitude about its value and usefulness (Wienclaw 2008) and some even suspect that there may be another technology bubble (Best 2006; Treese 2006). Research into the use of Web 2.0 within the agri-food supply chain, in particular, is still in its infancy, despite the importance of agri-food industry (DAFF 2012b, 2013b) and the constant pressure on primary producers to increase their productivity (Mallawaarachchi et al. 2009; Nossal & Gooday 2009).

More research is required into the significance of Web 2.0 for SMEs involved in supply chain management, particularly in terms of how Web 2.0 might assist primary producers (agri-food SMEs) integration with their supply chain(s).

2.5.1 WHAT IS WEB 2.0

The concept of Web 2.0 first emerged in a discussion session held during a 2004 web technology conference and the term is generally believed to have been coined by O'Reilly (2005).

There is no formal definition of the term as yet – TechWeb (2010), for example, offers a functional delineation: *"Web 2.0 is not a specific technology; rather, it refers to two major paradigm shifts. The one most often touted is 'user-generated content' which relates more to individuals. The second, which is equally significant but more related to business, is 'cloud computing'*, while Hoegg et al (2006) provide a structural elucidation of the term: *"the philosophy of mutually maximizing collective intelligence and added value for each participant by formalized and dynamic information sharing and creation"*. Despite the lack of a clear and unambiguous definition of Web 2.0, the increasing number of research articles written on this topic furnishes evidence of the widespread acceptance of the new term (Bughin & Manyika 2007; Chui et al. 2009; Goh et al. 2007; Mohan et al. 2008; Sena 2009).

2.5.1.1 WEB 2.0 PRINCIPLES

O'Reilly (2007) identified 7 principles of Web 2.0 to help people differentiate it from the original generation of web applications: 1) The Web as platform, 2) Harnessing collective intelligence, 3) Data emphasis, 4) Perpetual update, 5) Modular applications for flexible reassembling, 6) Highly platform-adaptable software; and 7) Rich user experience. There is not sufficient space to enable a detailed exposition of these principles, but most authors refer to at least some of these in discussing the phenomenon.

Web 2.0 is an umbrella term incorporating a number of functions, components and technologies. Hoegg et al (2006), noting that Web 2.0 is a philosophy rather than a technology (or even group of technologies), point out that it is based on the common vision held by its user community. These authors' 'fundamentals' of Web 2.0 is the maximisation of the users' collective intelligence, which they define as the "interactive exchange of information" and the "continuous development and maintenance of a group opinion" – which, together, lead to a "commonly accepted opinion or content" and which, to be truly effective, requires a “self-regulating community”. He et al. (2007) compared the characteristics between Web 2.0 and Web 1.0 in Table 2-3.

Table 2-3: Characteristics Web 2.0 vs. Web 1.0
(He et al. 2007)

Web 1.0	**Web 2.0**
System-centric	Users-centric
Proprietary	Open architecture
Monolithic	Simple and lightweight
Information Provider	Participatory

2.5.1.2 WEB 2.0 COMPONENTS AND TECHNOLOGIES

Goh et al. (2007) concluded four typical components of Web 2.0: rich internet applications, Software-as-a-Service (SaaS), collective intelligence, and mashups referred to the simultaneous combination of multiple applications into one user experience such as location-based services (Fusco et al. 2012; Lawton 2007; Michael & Michael 2011). The enabling technologies underpinning these components include: Ajax, RSS, Macromedia Flash, wikis, blogs & folksonomies, podcasts and tagging (Goh et al. 2007), but these are generally invisible to the user. An alternative categorisation of Web 2.0 applications combines them into 5 sets: blogs, social networks, content communities, forums/bulletin boards; and content aggregators (Constantinides & Fountain 2008), but considering that this grouping focuses on the final application rather than the application type, there is considerable similarity with Goh and colleagues’ list.

Although the classifications of Web 2.0 components and technologies vary from author to author, much of the research associated with Web 2.0 has tended to be concerned with ‘which of these components can be applied for business use?’ A summary of some popular business-used Web 2.0 components are: social networking (DiMicco et al. 2008; Ooi et al. 2011), collective intelligence (Hoegg et al. 2006), Software-as-a-Service (Goh et al. 2007), Application Programming Interfaces (APIs) (Andersen 2007), mashups (Goh et al. 2007), Ajax (Andersen 2007), Blog (Norfolk 2007; Ooi et al. 2011), podcast, tagging, and Really Simple Syndication (RSS) (He et al. 2007; Ooi et al. 2011).

Considering the abstract concept of Web 2.0, and for the sake of clarity, Web 2.0 has been defined as ‘collaborative web-based solutions based on user involvement and contribution’ for the purpose of this research project.

As with suspicions about the premise that the broad use of information technologies would lead to productivity improvement, many people are sceptical about the business potential of Web 2.0, which is commonly known as social networking and used mainly for entertainment.

2.5.1.3 THE VALUES OF WEB 2.0 TECHNOLOGIES ARE MORE CREDIBLE

Several studies have revealed the value of Web 2.0 technologies in business fields (ABC News 2012; Adebanjo & Michaelides 2010; Bughin & Chui 2010; Bughin et al. 2009). Two McKinsey Quarterly reports provide some guidance as to whether this concept is a passing fad or an enduring trend (Bughin & Chui 2010, 2013). These findings confirm that measureable benefits have been achieved by the businesses employing Web 2.0 (Bughin & Chui 2010, 2013). In particular, two thirds of respondents across a wide range of regions, industries, and functions report that Web 2.0 technologies have been adapted to their businesses and generally hold a positive view of the usefulness of Web 2.0 (Bughin & Chui 2010, 2013). Web 2.0 provides an interactive, open and collaborative platform that enables small businesses and even single individuals to overcome their lack of resources to compete with large corporations (Boyles 2011). Moreover Web 2.0 is an enabler of participatory information-sharing and user-generated innovation where users’ field knowledge, practical experience and expertise are contributing to the innovation (Ballantyne 2010).

The advantages of Web 2.0 (particular within the agri-food industry) include: an easy-to-use technology facilitating participation, communication and two-way information flow which is suitable for primary producers even if they lack ICT education and training (MBIE 2013; Sideridis et al. 2010). Web 2.0 applications including Facebook and Twitter enable citrus growers in South Australia to connect with their customers and sell their produce online (ABC News 2012).

In their case study of Web 2.0 enabled e-clusters in the UK food industry, Adebanjo & Michaelides (2010) determined that Web 2.0 can facilitate participation, enhance connectivity and help e-cluster members to benefit from e-procurement. The Department of Primary

Industries of Victoria Australia has proposed the FarmWeb 2.0 project which, by using a number of Web 2.0 technologies, is designed to enhance farmers' data management and facilitate a two way flow of data between government, industry and farmers/landholders (Department of Primary Industries 2012). This Web 2.0 platform is expected to improve farms' productivity while reducing their environmental impact (MBIE 2013). Grounded on the research of a Web 2.0-based livestock management system, Teng et al. (2012) compares the advantages offered by the Web 2.0 based system over desktop applications, and the results are illustrated in Table 2-4.

Table 2-4: Desktop Applications vs. Web 2.0 Systems (Teng et al. 2012)

Field	Desktop applications	Web 2.0 systems
Upgrade	Difficult and often accompanied by compatibility problems	Seamless upgrade at hosting station
Software Release cycle	Long release cycle	Constantly released
Technical Support	Difficult to diagnose remotely	Easy technical support by using the same web interface remotely
Accessibility	Limited to local computer	Any web-enabled devices such as PC, Mac and tablet
Data synchronisation	Inconvenient and data are not updated in real time	Constant real time synchronisation
Integration	N/A	Mashup function allows integration with other web services e.g. GPS-enabled devices integrate the system with Google Map to track animals' movement

Although the business potential of Web 2.0 is more credible and the potential is evidenced in the agri-food industry, there is little research into the application of Web 2.0 to the agri-food domain and even less focus on Web 2.0-enabled agri-food supply chains. A question that thus needs to be addressed is 'how could Web 2.0 potentially improve the supply chain management?'

2.5.2 WEB 2.0-ENABLED SCM

A number of researchers have investigated the application of web 2.0 to SCM and the strength of Web 2.0-enabled SCM. Ooi et al. (2011) have summarised SaaS and cloud computing, collaboration, Web as platform, crowd sourcing and power decentralisations as applications of Web 2.0 technologies in SCM. Web 2.0 is characterised by online interaction and collaboration which allows organisations to engage, communicate and integrate with minimal time and cost (James 2010). Internet-based technologies assist organisations in upgrading to inter-networked enterprises with more flexible organisational structures and greater efficiency (Ramsey & Ibbotson 2005). Web 2.0 provides an easy-to-use, economically affordable and collaborative solution for smaller food producers attempting to proactively engage in, and gain benefit from, supply chain management. Moreover, the social networking principles regarded as a special form of collaboration and multiple platforms/device adaptability are also an advantages of a Web 2.0-enabled SCM solution.

B2B interaction and communication are important elements in SCM. The collaborative, user-focused, dynamic Web 2.0 is widely expected to overcome the limitations of the more static Web 1.0 and provide a better solution for business integration. He et al. (2007) summarise the benefits Web 2.0 brings to enterprise integration by comparing the facilities offered by the two generations of Web application (see Table 2-5), showing clearly that Web 2.0 is focused on user needs, rather than being designed for the convenience of software developers or publishers.

Table 2-5: Web 1.0 vs. Web 2.0 for Enterprise Integration

(He et al. 2007)

Web 1.0	**Web 2.0**
Information Pull by users	RSS-XML based information Push Model
Traditional internet client webpage	Rich Internet Applications based on AJAX, API and mashups
Scheduled software release	SaaS enables continuous upgrade and performance improvements with lower cost and flexibility

The following sub-sections highlight some important issues for this group of potential supply chain contributors.

2.5.2.1 EASY-TO-USE

Web 2.0 provides a potential solution to interface problems among supply chain participants who need to inter-connect their own data (and, potentially, systems) with those of other supply chain partners. Incompatible interfaces among corporate partners can lead to confusing processes and the transmission of unreliable data (Auinger et al. 2009). Web 2.0 technologies may help to overcome these problems with their simple and intuitive interfaces and ready accessibility. They also offer the further benefit of supporting the integration of additional supply chain technologies, such as radio frequency identification (RFID) (Auinger et al. 2009).

Web 2.0 also has the capacity to simplify system maintenance and upgrade. Web 2.0-based systems help SMEs to overcome the difficulty of system maintenance, ongoing operation and support. This is a particular problem for SMEs with their lack of technical expertise and IT knowledge (Bunte et al. 2009; Tiessen et al. 2001; Vaaland & Heide 2007). The community nature of many Web 2.0 applications enables service providers to deliver a continually updated service that gets better the more people use it (O'Reilly 2007)..

2.5.2.2 AFFORDABLE

Web 2.0 offers a more affordable solution for SME supply chain participants (Kuchinskas 2007a; Teng et al. 2012). Making use of Web 2.0 technology to develop agri-food supply chain solutions can potentially reduce farmers' IT costs in both the implementation and maintenance stages of a software solution development. One of the most relevant components of Web 2.0 in terms of cost is Software as a Service (SaaS), which allows users to reduce the initial software purchase cost (Bunte et al. 2009), purchase the service or function they desire and use only as much of that service as they need (Ooi et al. 2011).

While there is considerable argument in the IT press over whether SaaS is really cheaper over the long term, Rothbart (2008) offers a very convincing costing analysis, including expenses for such items as hardware, additional software (e.g. operating systems, server software, etc.), implementation and maintenance labour which suggests that it would take nearly five years for a SaaS solution to equal the cost of a licensed one – by which time the firm would almost certainly have moved on to a new product.

It would thus be possible for a farmer to purchase the rights to only a basic version or a particular service or function of a supply chain solution, rather than having to buy the full installation and if, later, they should require a different set of modules, these could be added to the existing version, or could entirely replace it. As a further advantage, upgrades to SaaS software are often automated, so that users do not need to be concerned with the difficulties of upgrading to new versions or installing 'fixes' (Kingstone 2008).

2.5.2.3 A COLLABORATIVE ENVIRONMENT

Web 2.0 enables mutual information exchange and better engagement between supply chain partners (Ooi et al. 2011) which, in a rural or remote environment where collaboration and information exchange are not common benefits, would encourage innovation for the rural SME supply chain users (James 2010). Information and knowledge sharing is not easy to achieve, and the three conditions required are: removal of social, psychological and political borders; suitable processes, standards and agreements; and availability of easy, affordable and attractive infrastructure (Bunte et al. 2009). Web 2.0-enabled integration has the potential to improve the performance of SMEs in three different ways (Anderson 2006; Blinn et al. 2009; Warr 2008):

- Internal communication and knowledge building/ sharing;
- Better collaboration with business partners;
- Proximity to customers, and the exploration of new markets where there is demand for mass-customised, low-volume products.

Primary producers using Web 2.0 will thus have the opportunity to exchange ideas and build new solutions in a collaborative environment. As Kuchinskas (2007b) rather neatly explains:

> *"Web 2.0 technologies embrace the idea that the more people use a service or application, the stronger and more valuable it becomes ... even relatively passive tasks ... can have tremendous value when data from these activities is compiled to identify crowd-pleasing content or to reveal subtle relationships between seemingly disparate things"*.

In particular, social networking can be regarded as a form of collaboration, where friends, and the friends of friends, are able to collectively contribute to an idea. Social networking is important for substantial agricultural development as it enables mutual learning and collective negotiation and bargaining (Oerlemans & Assouline 2004). As an outcome of their study of ICT use in sea fishing industry, Chauvin, Morel & Tirilly (2010) found that there is substantial need for skippers and crew members to continue communicating in social networks, as this permits them to access necessary selective information at the lowest possible cost.

2.5.2.4 MULTIPLE PLATFORMS/DEVICES ADAPTABILITY

Web 2.0 enables the use of web-based services on a range of platforms rather than restricting access to a computer platform (O'Reilly 2007). This potentially suits primary producers' mobility needs. With the advent of, and an increasing popularity of, mobile devices, especially smartphones, the accessibility and mobility of web-based services have been improved dramatically over the past few years. Moreover, by incorporating a range of technologies such as GPS, build-in camera and voice control these mobile devices can perform functions such as location identification, information scanning and speed measurement (O'Reilly & Battelle 2009). These compound pocket-sized devices are competent to provide web-based service and tackle real-world problems. They provide a good opportunity for people who have used little unwieldy desktops before to experience online services (Waugh 2012).

The evidence from the literature thus suggests that SMEs in the agri-food industry can benefit from using Web 2.0, and that Web 2.0 principles can be applied to enhance supply chain management. So far, however, there is little research as to how Web 2.0 can enhance agri-food SMEs' supply chain management, and this forms the principal question of this research project.

As a project focusing on ICT acceptance, it is also necessary to understand the latest developments of telecommunication in the nation, especially in rural and regional areas where the majority of primary producers are based and, to this end, a brief discussion of Australia's very high-profile National Broadband Network (NBN) is now offered.

2.6 NATIONAL BROADBAND NETWORK AND ITS IMPACT ON E-SUPPLY CHAIN MANAGEMENT

When this research project began, the Australian government had proposed the National Broadband Network as an ambitious investment, which rapidly became the largest-ever technology infrastructure investment in Australia's history – and which remains the single most costly networking investment of any country in the world.

The NBN was designed to provide high speed broadband service to the majority of businesses and households in the country in the form of a direct fibre link to each household – known as fibre-to-the-home, or FTTH (NBN 2013). Despite the ongoing debate over its cost-effectiveness and the breadth of its coverage, the NBN project is regarded as an enabler to bridge the existing digital divide between urban and regional Australia, and therefore it carries high expectations in rural Australia (LeMay 2012). Its rollout in Tasmania will unquestionably affect Tasmanian farmers' ICT adoption to some degree. Thus it is necessary to introduce the topic of the NBN, and evaluate the impact of the NBN with particular focus on farmers, and especially on their agri-food supply chains.

2.6.1 DEBATES OVER THE NBN

Like any other infrastructure project, the NBN has both advantages and disadvantages. The widely differing opinions on the value of this project have become one of the most significant causes of dissent between the Australian Labor Party (ALP) and the Liberal/National Coalition (Bingemann 2010).

The ALP takes a positive view, insisting on the importance and necessity of the NBN to maintain Australia's competitiveness over the long term. The governing party has committed to deliver high speed broadband service on a financially viable basis at affordable prices to all Australians (Australian Government 2011a). In particular, the Labor Government has promised to connect 93% of premises with fibre providing speeds of up to 100 megabits per second (Mbps), and to offer broadband to the remaining premises by using a mix of next generation fixed wireless and satellite service at speeds exceeding 12 Mbps (Australian Government 2011a).

As promised in the 2010 election campaign, the Labor Government has been conducting the rollout in an unconventional order, which gives regional areas priority. The broadband services across three different platforms will be offered at a uniform wholesale price starting from Aus$24 per month. The Government expects the set wholesale price can be translated to an ultimate retail price, as the wholesale price is the key determinant of the retail price today (Australian Government 2011a).

By contrast, the opposition Coalition holds a negative view of the NBN and has criticised the NBN in terms of its cost effectiveness and the long-term usefulness of its technology. The Coalition has been against the expensive NBN which requires a reassessed total capital expenditure of Aus$35.9 billion and, more importantly, includes a $27.5 billion government contribution in equity for the rollout (Australian Government 2011a). The coalition has argued that the goal of the NBN could be achieved by a mix of fibre-to-the-node (FTTN) and wireless technologies at a much lower cost (Rodgers 2010), and the government monopoly project (Dobbie 2011b) without scrutiny would not be cost effective (Fletcher 2011).

Comparisons of different broadband roll out strategies that have been made with other developed nations highlight how expensive the Australian broadband approach is. The dissenters compare Australia's NBN with the United States' high speed wireless project, in terms of funding mode and mobility (Martin 2011). The comparison highlighted the low cost and mobility features of the US's choice, and thus criticised Australia's NBN on these two aspects (Martin 2011). New Zealand has also taken a different approach to Australia for its national broadband network, which consists of two initiatives: the Ultra-Fast Broadband

(UFB) initiative and the Rural Broadband Initiative (RBI) (MBIE 2013; McDonald 2012) which are both public-private partnerships building on existing commercial infrastructure and technologies. The UFB and RBI together expect to deliver faster broadband to 97.8% of the 5 million New Zealanders who will receive the benefit of the New Zealand government's investment of $1.2 billion and $234.7 million respectively (MBIE 2013; McDonald 2012). The total amount of $1.434 billion is significantly less than Australia's $37.4 billion project.

The Coalition has also criticised the rollout schedule where, in exchange for the support of a small group of independent members of parliament representing rural and regional electorates, the Government has turned the business case for the NBN on its head: rural and regional areas will get priority for the NBN rollout (Morgan 2010). This arrangement makes it impossible for the service in low-cost and high-income areas to generate sufficient cash flow to subsidise the rollout in high-cost and low-return rural areas (Morgan 2010), which eventually will dramatically increase the government investment (LeMay 2010).

In the face of the challenges of the NBN, the Labor Government has defended the FTTH approach as the backbone of any wireless alternative (LeMay 2011), and has claimed that this has the potential to carry more data at higher speeds as fibre-optic technology improves (Ramadge 2011; Taylor 2011a).

2.6.2 IMPLICATIONS OF THE NBN FOR THE SME'S AGRI-FOOD SCM

It is still too early to assert the correctness or otherwise of the NBN at this early stage, but it is possible to evaluate the possible advantages and disadvantages according to Government policy, and facts emerging from the initial rollout. More importantly, what matters from the point of view of this research project are the implications for farmers and especially for their agri-food supply chains.

2.6.2.1 POSSIBLE ADVANTAGES OF THE NBN FOR SME SUPPLY CHAIN MANAGEMENT

This section summarises three possible advantages of NBN for enhancing SMEs supply chain management.

- Enabling the Rural Communities to Use High Speed Broadband

According to the Labor Government, the NBN will provide rural and remote areas with access to broadband Internet via either fibre, wireless or satellite and will substantially improve the information service in these areas (Australian Government 2011b) which currently have very poor telecommunications infrastructure compared with urban areas. In particular, this development could provide people residing in rural areas with better access to information resources and specialist services typically found in urban areas (Australian Government 2011b), which means that farmers will benefit from the development of NBN even ahead of the urban dwellers.

- Optimising Supply Chain Management

Under the NBN, supply chains could potentially be optimised by the dramatically enhanced broadband capacities which enable transmission of high quality documents, images, audios and videos, as well as implementation of smart technologies (Australian Government 2011b).

- Conducting more ICT Research

Under the NBN, a large amount of research funding will be provided and significant amounts of research encompassing the project will be conducted (Hutchinson 2011; Taylor 2011b). As a result, the ICT-enabled agri-food supply chain management field could also benefit from the research 'high tides' in the context of the NBN roll-out.

2.6.2.2 POSSIBLE DISADVANTAGES OF THE NBN FOR SME SUPPLY CHAIN MANAGEMENT

The construction is designed to provide substantial infrastructure for farmers and farming SMEs in rural areas to enable internet access (Prime Minister et al. 2009) and potentially permit them to embark on supply chain management via the Internet (DBCDE 2010). However the Internet access fee and the cost of installation might be the main concerns of the users. In addition, the very limited perceived benefits and the substantial maintenance costs are also negative factors for the NBN. Residents in rural and remote areas want affordable and reliable Internet access rather than an expensive and extremely high speed broadband (Cox 2010).

- Possible high cost for rural communities

There are several unclear factors, such as the pricing models, additional installation fees, and life expectancy of fibre which contribute to the potentially high cost for rural communities to use the NBN.

Despite promises, the NBN may not be able to deliver a uniform price across different platforms in future as this could potentially bankrupt the NBN (Wilson & Packham 2011). The uncertainty of the pricing model may result in rising costs to use the NBN in rural areas, which would inhibit broadband adoption by farmers and thus make it impossible for them to embark on ICT-enabled SCM.

Moreover, according to The National Electrical and Communications Association chief executive, James Tinslay, to take full advantage of the NBN residents would still need to pay up to A$3,000 to install new cables and devices to accommodate the fibre-optic cables (Maher & Bingemann 2010). In addition to the extra costs of cable and device installation, a potentially higher Internet access fee could be another inhibitor for users, (especially for non-metropolitan users) to embark on the NBN (Morgan 2010).

- Limited life expectancy of fibre cables

The life expectancy of the fibre being laid is another factor that may concern people. The possible short life expectancy of the fibre may require additional funds for future replacement, and will eventually be transferred to the users (Dobbie 2011a).

- Little perceived benefit

Some farmers are still sceptical about the usefulness of the NBN, as they can see little direct or immediate benefit for their business from the large government investment. (ABC News 2011b).

The adoption of NBN is predicted by relative advantage, utility outcomes and facilitating conditions (Hill et al. 2011), thus more research in utilising NBN could potentially enhance the NBN uptake.

2.6.3 IMPACT OF THE NBN ON THIS PROJECT

High-speed broadband enables the utilisation of the most recent Web technologies, especially Web 2.0 applications (Kern 2008), however, the impact of the NBN on SCM is not significant. Web 2.0 technologies do not require huge volumes of data communication nor rely heavily on broadband service, though high speed Internet service will certainly support Web 2.0-enabled SCM. The debate and uncertainty over the NBN should not have any significant effect on this project. The project, instead, offered an opportunity to discover whether the NBN could really make a difference to the business activities of Tasmania's rural population.

Following a review of the relevant literature, the literature gap concerning the acceptance of Web 2.0 to enhance agri-food SMEs' supply chain management was identified.

In the next section a number of technology acceptance models are reviewed for the development of an acceptance model that would underpin the research project.

2.7 RESEARCH MODEL

This section reviews a number of potential acceptance models that could be employed as a fundamental framework for the research.

2.7.1 ACCEPTANCE THEORIES

Over the past three decades, a number of Information Systems researchers have investigated the factors affecting acceptance of computer systems (Davis et al. 1989; Venkatesh et al. 2003). Many scholars have proposed models to associate predictors and actual behaviour in a bid to predict users' response to and adoption of new technology (Davis et al. 1989). Broadly speaking, this research has focused on theories which enable the forecasting of user behaviour according to a number of related variables. This research can be subsumed under the umbrella term of 'acceptance theories'.

This research project was designed to explore the ability of Web 2.0 to enhance supply chain integration and, therefore, involved user acceptance of Web 2.0 technology. In this context it was essential to introduce the acceptance theories as underpinning frameworks to diagnose and examine new technology acceptance.

Since the technology acceptance theories stem from general acceptance theories, the logical place to start this section was with initial acceptance theory. This provided a jumping-off point for a more detailed discussion of the best-known theories in this area of user adoption and uptake.

2.7.2 THEORY OF REASONED ACTION

Theory of Reasoned Action (TRA) is one of the most popular models used by researchers in studying the determinants of consciously intended behaviour from a social psychology standpoint (Ajzen & Fishbein 1980). TRA (see Figure 2-3) suggests that a person's Behaviour Intention (BI) is the key predictor of his/her actual behaviour, while Attitude Toward Behaviour (A) and Subjective Norm (SN) are determinants of BI.

According to TRA, BI is a measure of the strength of one's intention to perform a specified behaviour (Fishbein & Ajzen 1975, p288). A is defined as an individual's positive or negative feelings (evaluative affect) about performing the target behaviour (Fishbein & Ajzen 1975, p216). SN refers to "the person's perception that most people who are important to him think he should or should not perform the behaviour in question" (Fishbein & Ajzen 1975, p302).

A person's attitude toward a particular behaviour is determined by his/her salient beliefs (b_i) concerning the consequences of performing the behaviour, multiplied by an evaluation (e_i) of those consequences. Beliefs (b_i) are defined as the individual's subjective probability that performing the target behaviour will result in consequence *i*. The evaluation term (e_i) refers to "an implicit evaluative response" to the consequence (Fishbein & Ajzen 1975, p29).

TRA theorizes that an individual's subjective norm (SN) is determined by a multiplicative function of his/her normative beliefs (nb_i), i.e., perceived expectations of specific referent individuals or groups, and his or her motivation to comply (mc_i) with these expectations (Fishbein & Ajzen 1975, p302).

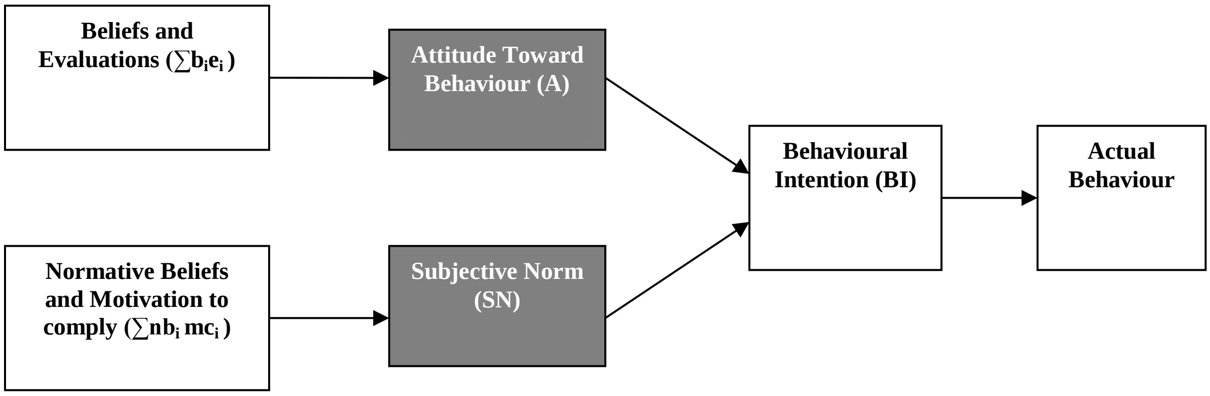

Figure 2-3: Theory of Reasoned Action

Figure 2-3 highlights the relationship between these factors although, as a general model, its generalization is a double edged sword. TRA can be roughly applied to bridge beliefs and a wide variety of actual behaviour, but it is limited by its inability to make precise predictions in specific contexts.

2.7.3 Technology Acceptance Model

With the goal of proposing a specific acceptance mode within the Information Technology (IT) domain, Davis Bagozzi and Warshaw (1989) tailored TRA into the Technology Acceptance Model (TAM). Consistent with TRA, Actual System Use is determined by Behavioural Intention to Use (BI) in TAM. However for BI, there are several changes: Attitude Toward Using (A) becomes the precursor to BI and both Subjective Norm (SN) and Attitude Towards Behaviour (A) are replaced by Perceived Usefulness (U) and Perceived Ease of Use (EoU). As users' experience of the target system increases, U affects BI directly, while EoU maintains its impact on BI both directly and indirectly via U. TAM also theorizes that external variables (e.g. system characteristics, development, process and training) affect intention to use via U and EOU (Venkatesh & Davis 2000).

According to TAM, Perceived Usefulness is defined as the degree to which a person believes that using a particular system will enhance his/her job performance (Davis et al. 1989, p985) while Perceived Ease of Use is the degree to which a person believes that using a particular system will be effortless (Davis et al. 1989, p985). Venkatesh (2000) suggests that this means people believe technology will be more useful as it becomes easier to use(Venkatesh 2000).

TAM identifies several important issues in the field of Information Systems acceptance: 1) an individual's actual adoption behaviour is determined by his/her Intention to Use; 2) the perceived usefulness of a target system outweighs ease of use as the primary determinant of an individual's Intention to Use (i.e. people are willing to tolerate a difficult or complex interface as long as the system provides useful or important functionalities) (Davis et al. 1989); and 3) although Perceived Usefulness and Perceived Ease of Use are two fundamental and distinct constructs in TAM, the impact of Perceived Ease of Use lessens as a user's experience with the system increases. An individual's Intention to Use is only directly affected by Perceived Usefulness, but Perceived Ease of Use maintains an indirect impact via Perceived Usefulness (Davis et al. 1989). Figure 2-4 illustrates the relationship of the factors affecting actual technology usage in TAM.

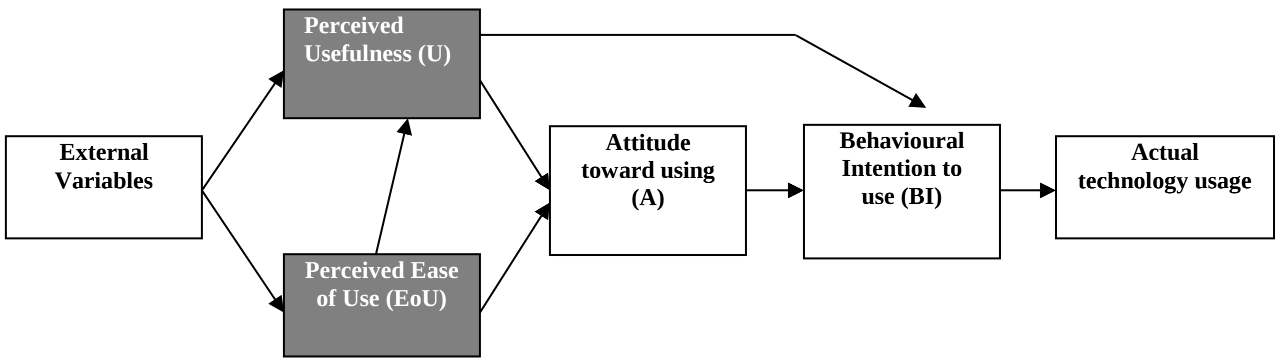

Figure 2-4: Technology Acceptance Model

2.7.4 TECHNOLOGY ACCEPTANCE MODEL 2

TAM is a well-established and robust model (Venkatesh & Davis 2000) but, despite its popularity as an indicator of Information Systems acceptance, the majority of the research which has been undertaken into Intention to Use has focused on Perceived Ease of Use, rather than on Perceived Usefulness. Venkatesh and Davis (2000) therefore extended TAM with the goal of investigating the determinants of the perceived usefulness and usage intention constructs. In addition, TAM2 examines the way(s) in which these determinants have changed over time as users' familiarity with the target system increases.

As shown in Figure 2-5, TAM2 removed Attitude Toward Using (A) from the model altogether, while modifying Behavioural Intention to Use (BI) and Actual Technology Usage to the simpler Intention to Use and to Usage Behaviour. This much simpler core was then surrounded by two groups of Processes: Social Influence processes (Subjective Norm, Voluntariness, and Image) and Cognitive Instrumental processes (Job Relevance, Output

Quality and Result Demonstrability). These processes almost all directly affect Perceived Usefulness and the Social Influences also directly affect Intention to Use. Perceived Usefulness directly, and Perceived Ease of Use both directly and indirectly via Perceived Usefulness, then affect Intention to Use and are significant factors in people's acceptance decision. Usage Behaviour is affected only by Intention to Use. The model’s developers concluded that the impact of social influence processes on users’ acceptance gradually decreases as familiarity with the target system increases, whereas cognitive instrumental processes continue to have a constant impact (Venkatesh & Davis 2000).

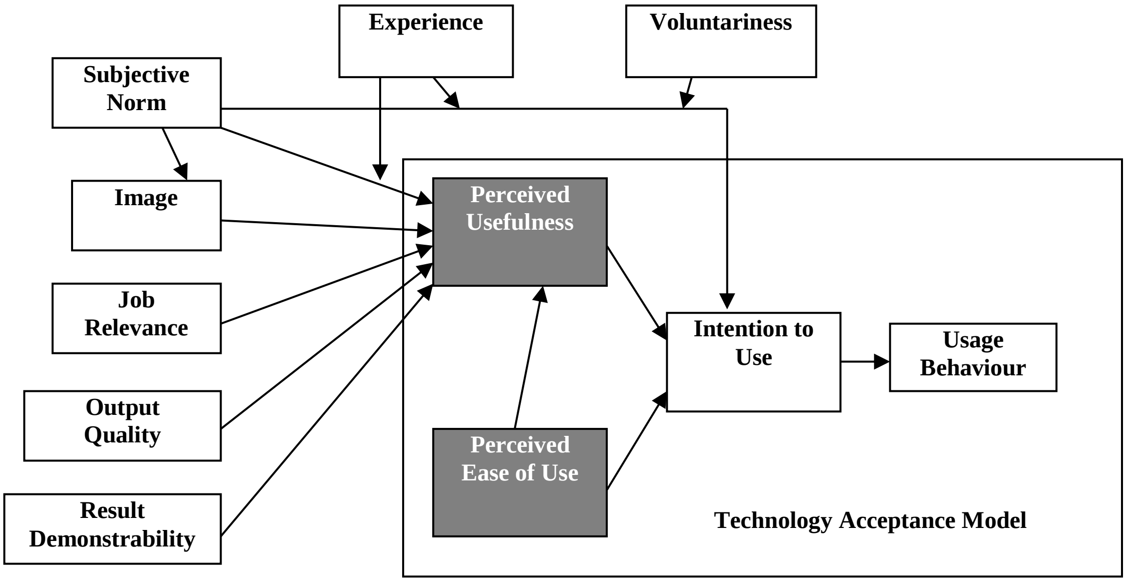

Figure 2-5: Technology Acceptance Model 2

TAM and TAM2 have both been widely employed to predict actual technology acceptance in the field of Information Systems, but studies (Parker & Castleman 2009; Venkatesh et al. 2003) have suggested that reality does not match the hype predicted by the models particularly well. One possible explanation may be that these models largely ignore the impacts of several important moderators such as users’ age and gender etc. on the determinants (Venkatesh et al. 2003).

2.7.5 UNIFIED THEORY OF ACCEPTANCE AND USE OF TECHNOLOGY

The existence of several competing technology acceptance models, for example TAM 3 (Venkatesh & Bala 2008) and the RuTADIM 1.2 Model (Lu & Swatman 2009), with roots in a variety of subjects, provides difficulties for researchers attempting to select and apply an appropriate model to their studies. Each model has reasonable constructs, but none of the models is able to provide a complete picture. Venkatesh et al. (2003) proposed a model, Unified Theory of Acceptance and Use of Technology (UTAUT), which they hoped would provide a unified view of user technology acceptance, grounded on eight prominent models in the technology acceptance field.

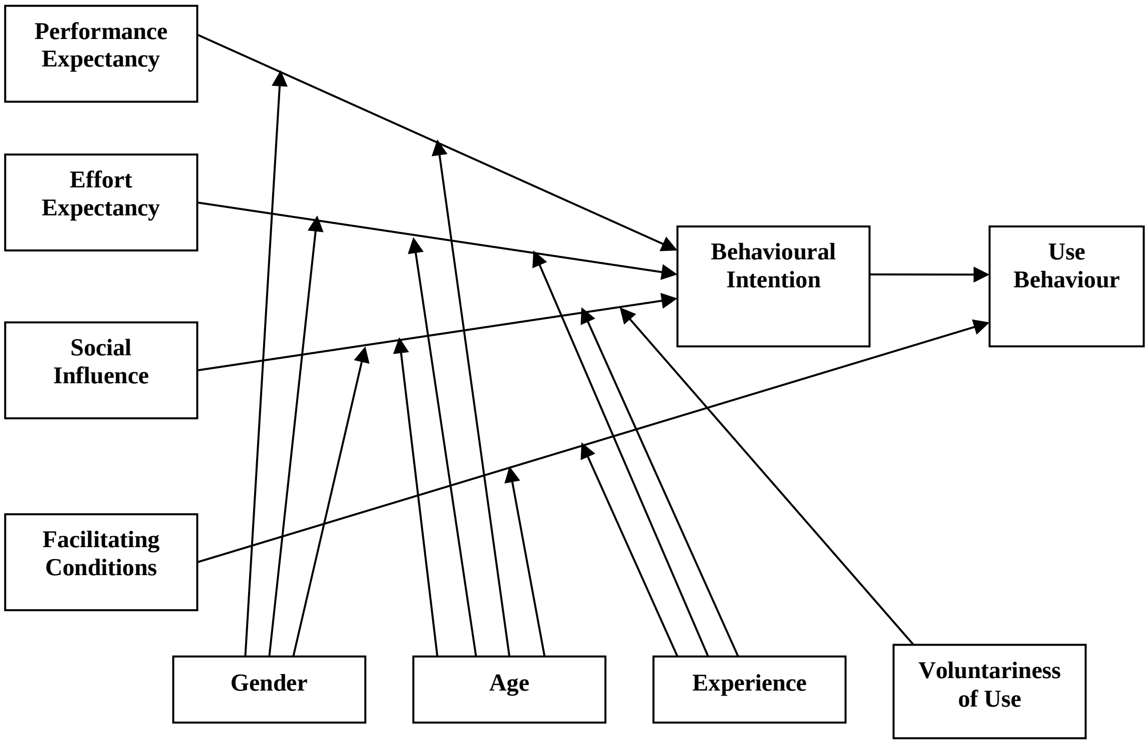

Figure 2-6: Unified Theory of Acceptance and Use of Technology Model

As Figure 2-6 illustrates, the compound model confirms that Behavioural Intention is indeed a determinant of Use Behaviour – but not the only one. Facilitating Conditions (the degree to which an individual believes an organizational and technical infrastructure exists to support use of the system) is also a direct determinant of Use Behaviour. Behavioural Intention is jointly determined by Performance Expectancy, Effort Expectancy, and Social Influence – and all these factors are, in turn, influenced by Gender, Age, Experience and Voluntariness of Use.

UTAUT integrates eight partial models and is designed to provide a holistic prediction of user behaviour and willingness to adopt new information technology solutions. Compared to the previous models, this model has more effective explanation strength (Wu et al. 2007a).

2.7.6 THE RURAL WEB 2.0 TECHNOLOGY ACCEPTANCE MODEL

As briefly mentioned above, a preliminary research model has been developed to explain and predict the acceptance of Web 2.0 solutions for supply chain management by agricultural SMEs. Given the predominantly positivist and exploratory nature of this research project, the consideration of an acceptance model for Web 2.0 was begun with Venkatesh et al's (2003) UTAUT.

2.7.6.1 JUSTIFICATION OF SELECTING UTAUT

UTAUT seemed appropriate because of its compound nature and previously successful employment in the similar context (Peris et al. 2013; Wu et al. 2007b).

At the outset its compound nature leading to superior explanation strength (Wu et al. 2007a) enables the investigation of influences on supply chain management associate with the context of primary industry, networking and interaction-emphasised technology where the moderators available in UTAUT such as gender, age, experience and voluntariness play important roles.

Furthermore its successful employments in the research of Web 2.0 acceptance of regional SMEs (Peris et al. 2013) shows that it is competent to be applied to this research focusing on the adoption of the same technology, Web 2.0, for the similar parties, SMEs mainly based in rural and regional areas.

Admittedly, the real world is too complicated to be fully understood by any single model. Nonetheless, UTAUT appears to offer an especially effective option for investigating new technology acceptance of the Small and Medium Enterprises in agri-food industry.

2.7.6.2 JUSTIFICATION OF MODIFYING UTAUT

Upon analysis, however, UTAUT proved only partially relevant to an investigation of the regional environment, with its characteristic needs – and the project therefore adapted and extended UTAUT to suit those specific needs – an approach which has been taken by a number of other researchers using this model as the starting-point of their own exploration (see, for example, Lin and Anol (2008); Sykes et al. (2009); Wang and Wang (2010) or (Pardamean & Susanto 2012).

The modification of the model and the justifications are listed below.

- Specifies the Performance Expectancy and divides it into Time savings and Cost savings;

In order to collect more specific information, the umbrella term Performance Expectancy is divided into Time savings and Cost savings which are considered as important for farmers' information system acceptance (Lu & Swatman 2009; Wilkins 2005, p136)

The first determinant in the model, time savings, refers to the degree to which an individual believes that using the system will help him/her to achieve greater efficiency and save time. Time Saving is a widely cited and significant factor affecting farmers' perception of information systems acceptance (Lu & Swatman 2009; Wilkins 2005, p136).

The second determinant in the model, Cost Savings, refers to the degree to which an individual believes using the system will assist in reducing operating costs. Due to their very limited financial support (Jutla et al. 2002; Vaaland & Heide 2007), Cost Saving is a very important factor for farmers (Lu & Swatman 2009; Wilkins 2005, p136). According to Southwood (2004) Cost Savings might well be more important than an increase in sales when considering the profitability of an IT investment. This variable is therefore considered a particularly significant determinant of IT acceptance.

- Incorporates Communication Quality as a determinant into the model;

The third determinant is Communication Quality and this distinguishes Web 2.0 technology acceptance models from previous Web 1.0 technology acceptance models. The critical aspect of this determinant is the two-way communication enabled by Web 2.0 which covers all aspects of rural access to better and more information: wider markets, a more inclusive community, and with the provision of innovation potential (James 2010).

Two-way communication enables progressive enhancement of both the quality as well as the quantity of information which can be acquired by farmers (James 2010), while accurate and, especially, adequate information exchanges enable better decision-making by supply chain participants (Philip 2008). This determinant is particularly important for agricultural SMEs which have traditionally suffered from poor quality information services. Because there are significant gender (Stewart 2004b; Whitley 1997) and age (White & Weatherall 2000) differences in attitude to computers, it was hypothesised that these two moderators might affect Communication Quality.

- Remove Facilitating Conditions;

Facilitating conditions refers to a range of objective factors perceived to ease the difficulties for ICT adoption (Venkatesh et al. 2003). This is the only determinant that has a direct impact on Use Behaviour without going through Behavioral Intention. For clarity, Facilitating Conditions was removed from the model in this exploratory research. However, the objective and external environments that may affect the ICT adoption were still considered in the empirical research and it is possible to restore the Facilitating Conditions as a determinant if it is deemed necessary.

- Retain Social Influence as a determinant

Social influence is *"the degree to which an individual perceives that important others believe he or she should use the new system"* (Venkatesh et al. 2003, p451). The Social Influence determinant is used to predict farmers' Web 2.0 technology acceptance based on several studies suggesting that social influence significantly affects users' ICT acceptance (Bunte et al. 2009; Sykes et al. 2009) and it is also the case for SMEs in their regional networks (Peris et al. 2013). As with UTAUT, it was hypothesised that Social Influence would be moderated by Gender (Wang et al. 2009), Age (Wang et al. 2009) and Experience (Venkatesh et al. 2003). However, in this study two separate experience moderators have been identified: domain-related and technology-related.

- Retain Effort Expectancy as a determinant

The final determinant, Effort Expectancy, is defined as "the degree of ease associated with the use of the system" (Venkatesh et al. 2003, p450). Research on acceptance of Web 2.0 for the SMEs in regional network found that Effort Expectancy is an important determinant in the UTAUT (Peris et al. 2013). Thus it is retained in the proposed framework for this research. As in the case of UTAUT it was hypothesised that this determinant would be moderated by Gender (Stewart 2004a, 2004b), Age (Wang et al. 2009) and both of the Experience (Venkatesh et al. 2003) variables.

- Modification of Moderators

Age and gender are two widely cited moderators in the adoption model (Stewart 2004b; Wang et al. 2009; White & Weatherall 2000; Whitley 1997) thus they were retained in the model for investigation and validation.

In order to gather more specific information ‘experience’ has been further divided into Technology Experience and Domain Experience. This modification is supported by Devaraj et al. (2008) who have identified that work experience is related to technology acceptance and Koivumaki et al. (2008) who have identified familiarity with a device and user skills as two factors affecting user perception of an information service. These finding can be reasonably extended to the Domain Experience and Technology Experience moderators.

The Voluntariness of Use is removed from the model for two reasons: firstly the majority of Web 2.0 technologies are free and their uses are voluntary; secondly, the trial of the prototype encompassing a number of Web 2.0 features that were provided during the interview was also voluntary. Thus it is not necessary to keep this moderator in an ICT adoption environment that is voluntary.

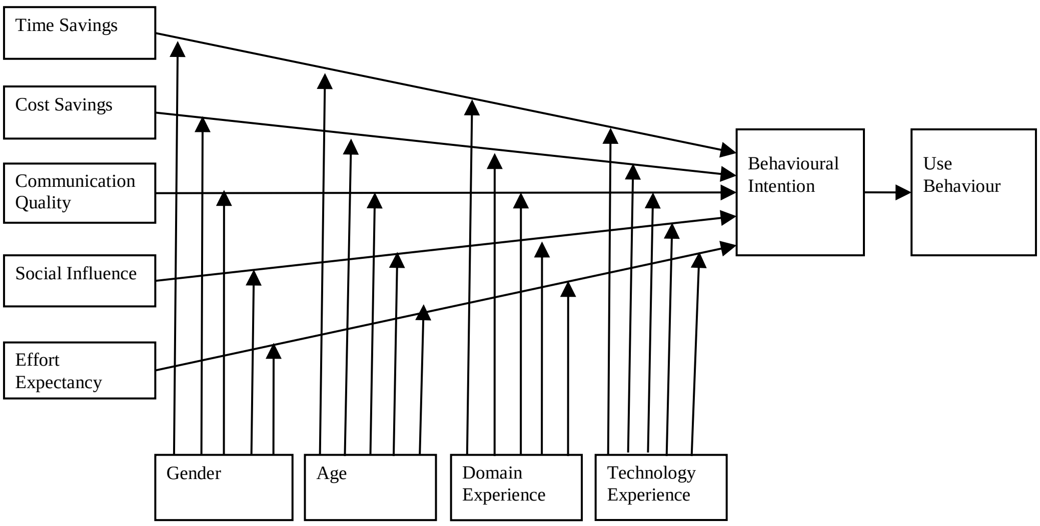

Figure 2-7: The Rural Web 2.0 Technology Acceptance Model

Figure 2-7 illustrates the modified version of the UTAUT model which, for convenience, was named the Rural Web 2.0 Technology Acceptance Model (RuWebTAM), and which is discussed below. It should be noted that, at the initial stage, it was not clear whether all the determinants would be affected by all the moderators, but the full range of such possible inter-relationships were included in this preliminary model.

This initial model, based as it is on the somewhat limited literature of ICT use and supply chain management in agri-food industry, was progressively refined as the research proceeded. The empirical data were then used to test these for accuracy and the final model was modified accordingly. In particular, the linkages between determinants and moderators were revised as understanding of Tasmanian primary producers progressed.

2.8 RESEARCH QUESTIONS

In order to fill the literature gap that has been identified in the previous section in this chapter, a main research question and six subsidiary research questions have been developed. The principle research question reflecting the essence of this research project is:

Can Small and Medium Enterprises in the agri-food industry, especially primary producers, use Web 2.0 technologies to enhance their supply chain performance?

As is often the case, the over-arching question is too complex to be answered as it stands. For the sake of clarity, therefore, the main research question has been divided into six (6) subsidiary research questions (SRQs). The answer to each question will be generated from the various research phases of this project in sequence. The aggregate findings of the SRQs will then provide the answer to the over-arching research question.

Subsidiary research questions (SRQs):

SRQ1: What evidence exists that SMEs in the agri-food sector can use Web 2.0 technology to link more efficiently with their supply chain?

SRQ2: What frameworks have been developed to explain the use of Web 2.0 technologies?

SRQ3: How are individual SMEs using ICT for their supply chain management?

SRQ4: What is the current state of agri-food SMEs' use of Web 2.0 in managing their agri-food supply chain?

SRQ5: What differences exist between each agri-food sub-sector in applying Web 2.0 technology to their supply chain?

SRQ6: How effective are Web 2.0-based approaches to supply chain management for Tasmanian agri-food SMEs?

2.9 CONCLUSION

Chapter 2 has provided a comprehensive literature review covering a number of disciplines and perspectives which formed the basis for the development of a research model entitled the Rural Web 2.0 Technology Acceptance Model (RuWebTAM) for Web 2.0 adoption in the agri-food industry in rural areas.

By outlining the existing work in the ICT adoption in SME's agri-food supply chain management, this chapter has identified the lacuna that the Web 2.0 SCM project seeks to fill. In particular, despite motivations, there are a range of obstacles for SMEs, and especially for the primary producers in the agri-food industry, to apply ICT to their SCM, whereas there is a potential for Web 2.0 to fill the gap. These outcomes form the basis for the development of the main research questions and the six subsidiary research questions as well as the empirical data-gathering and data analysis.

Chapter 3

Research Methodology

This chapter is based around a publication presented at the International Conference on Internet Technologies & Society (ITS 2012) Perth, Australia (Liao et al. 2012)

3.1 INTRODUCTION

In the previous chapter the literature review has shown how little information exists concerning primary producers' ICT applications in their agri-food supply chain management and, more importantly, how little information is available on the Tasmanian situation. This research project is designed to fill the gap. In this chapter the research methodology employed for this research project will be discussed. The selected research methodology served as a framework which determined the process used to ascertain answers for the research question – the potential of Web 2.0 technologies to enhance SMEs' agri-food supply chain management.

Section 3.2 presents an overview of the Information Systems (IS) research paradigm, followed by: Section 3.3 – Taxonomies of Information Systems Research Methods. Section 3.4 discusses the selection of the research approach selected; and Section 3.5 presents the research design. Section 3.6 concludes the chapter.

3.2 OVERVIEW OF INFORMATION SYSTEM RESEARCH

In social science research there are three primary philosophical approaches: positivist, interpretive and critical social science (Neuman 2006). This classification is also widely applied in Information Systems research (Orlikowski & Baroudi 1991).

Of these three classifications, positivist studies are the most widely used in social science, with interpretive studies being rather less popular, and critical studies being comparatively rare in Information Systems research (Orlikowski & Baroudi 1991).

The present research project, based predominantly on factual data, was designed to investigate the impact of Web 2.0 on SMEs' agri-food supply chain management. The exploratory findings of the project relied on a combination of the objective impact of Web 2.0 together with a subjective interpretation of users' experiences. This combination suggested that a mixture of positivism and interpretivism would be the most appropriate philosophy to guide the research.

3.3 TAXONOMIES OF IS RESEARCH METHOD

Research in the Information Systems domain can be classified by means of a variety of different taxonomies in terms of research purpose, approach and nature of data. This Section presents three taxonomies of Information Systems research.

3.3.1 EXPLORATORY VS. EXPLANATORY VS. DESCRIPTIVE

Prior to conducting any research project it is necessary to understand the purpose of the enquiry. There are three possible types of research purpose, depending on the final goal of the researcher: to explore a new field, to describe a social phenomenon; or to explain the reasons for the occurrence of the phenomenon (Neuman 2012, p16). These three research aims are, respectively, known as exploratory, explanatory, or descriptive research (Neuman 2012, p16).

Exploratory research is used when problems are in a preliminary stage and concerns “what” type questions; explanatory research concerns the reasons for an occurrence and refers to “why” question such as “Why does this occur in this way?”; while descriptive research focuses on “who” and “how” questions such as “How did it happen?” and “Who is involved?” (Dubé & Paré 2003; Neuman 2012, p16-17).

Web 2.0 is a new concept and comparatively little study has yet been undertaken into its application to business – especially by SMEs. The research project was thus an exploratory study of reality, based primarily on factual data and information.

3.3.2 DEDUCTIVE VS. INDUCTIVE APPROACHES

From the point of view of research approaches, there are two alternatives: deductive and inductive (Bryman 2004, p8). Taking a deductive approach, the researcher bases one or more hypotheses in a particular domain which are then tested and either confirmed or rejected by empirical data. In the inductive approach, by contrast, the researcher makes use of empirical findings to build inferences and create theory from empirical data theory (Bryman 2004, p8). Figure 3-1 compares the deductive and inductive approaches.

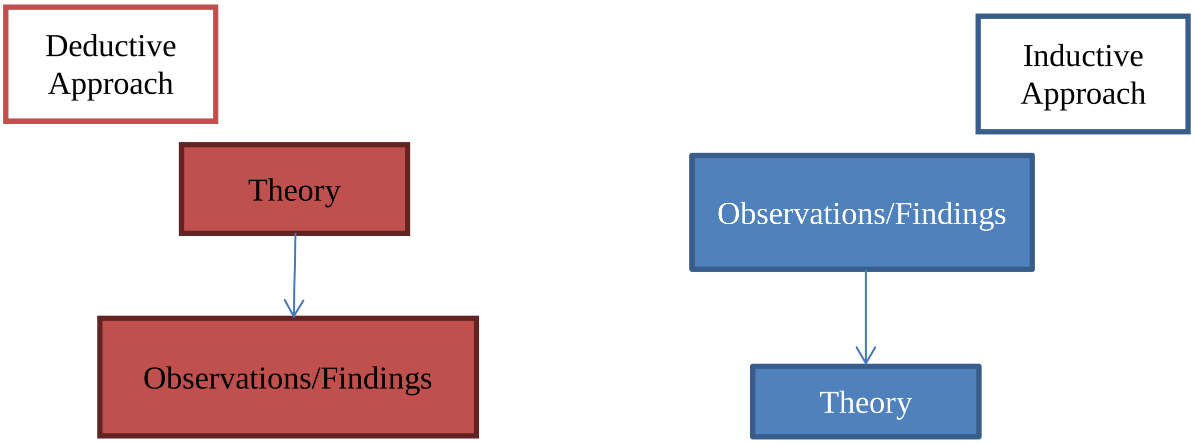

Figure 3-1: Deductive and inductive approaches to the relationship between theory and research (Bryman 2004, p10)

Deductive reasoning which applies known ideas or theories to test their relevance in a given situation (Neuman 2006) is most appropriate for hypothesis testing and other forms of causal research. In contrast, inductive research, which uses empirical data-gathering to formulate concepts or theories, is the most appropriate (or even the only) feasible way of conducting exploratory research (McMurray et al. 2004).

The present research project was exploratory as there is little understand about the use of Web 2.0 for primary producers to enhance their SCM, Thus adoption of an inductive research process was the most appropriate and feasible approach to take (McMurray et al. 2004).

3.3.3 QUANTITATIVE VS. QUALITATIVE

Finally, research can be categorised as either quantitative or qualitative in nature (Walter 2010, p67). There are significant differences between these two distinguishing approaches. Quantitative research relies on the collection and measurement of predominantly numerical data and has the potential to allow generalisation of findings following statistical analysis (Neuman 2006). It concerns "what?" and "how many?" questions, the answers to which may be used to explain human behaviour (Walter 2010, p68). Quantitative research tends to present a representative outcome by collecting and analysing a large scale of data (Walter 2010, p68).

Qualitative research, by contrast, examines related (narrow but rich) detailed information obtained from social interaction between participants and researchers (McMurray et al. 2004). It concerns "what meaning?" questions by gathering and interpreting people's opinions

(Walter 2010 ,p68). Table 3-1 compares the major differences between quantitative and qualitative research.

Table 3-1: Contrasts between Quantitative and Qualitative Research (Bryman 2004, p287)

Quantitative	Qualitative
Numbers	Words
Point of view of researchers	Points of view of participants
Researcher distant	Researcher close
Theory testing	Theory emergent
Static	Process
Structured	Unstructured
Generalisation	Contextual understanding
Hard, reliable data	Rich, deep data
Macro	Micro
Behaviour	Meaning
Artificial settings	Natural settings

Data can be collected using either quantitative or qualitative research methods, and both quantitative and qualitative methods can be used for positivist research. However, interpretive research is most appropriately handled by qualitative methods (Neuman 2006; Walter 2010, p23).

Despite the significant differences between qualitative and quantitative methods, the combination of these two approaches is by no means uncommon in social science research, as they are complementary rather than contradictory (Jick 1979).

As discussed in Section 3.4 and Section 3.5 this research employs survey as research method and semi-structured interview based on questionnaire as data gathering techniques to gather data, so the data is both countable and uncountable. The countable data such as age, gender, year of working experience were gathered to form the base of the analysis. In addition uncountable data was gathered to supplement the countable data. The uncountable data include what type of ICT, especially Web 2.0 that have been used to enhance their SCM, as well as their opinion about the factors affecting their Web 2.0 adoption. This research includes both countable and uncountable data, and therefore this research is both quantitative and qualitative.

3.4 SELECTION OF RESEARCH APPROACH

Given the use of both quantitative and qualitative methodologies, a research project can employ a wide variety of research methods. Survey and case study are popular research methods used in Management Information Systems (MIS) (Pinsonneault & Kraemer 1993) and were considered for this research project, as was Rapid Appraisal, a technique adapted from agricultural science which Wilkins, Swatman & Castleman (2004) advise is also very appropriate for IS research. The sub-sections which follow discuss each of these three candidate approaches in more detail and, in Section 2.5, the selection of the research approach for this particular study is explained.

3.4.1 SURVEY

Survey has been one of the most popular method kits for social science researchers for several decades (Chadwick et al. 1984; Neuman 2012, p172; Walter 2010 ,p152). A survey is a means of *"gathering information about the characteristics, actions, or opinions of a large group of people, referred to as a population"* (Pinsonneault & Kraemer 1993). An alternative description of survey is *"a research method that applies the same questions measuring variables to all respondents to obtain comparable answers"* (Neuman 2012, p173).

Characteristics of surveys are, firstly, the production of quantitative descriptions of some aspect of the study population; secondly, the collection of data stemming from the answers to structured or predefined questions; and, thirdly, the potential to generalise the fraction of responding answers to the total study population (Pinsonneault & Kraemer 1993). As compared to other research methods, the distinguishing features of surveys are the form of data referring to a structured or systematic set of data, and the method of analysis referring to a comparison of cases (de Vaus 2002, pp. 1-5).

Like any other research method, survey has strengths and weaknesses. Its strengths are summarised by Walter (2010, p152) as follows:

- Survey can be applied to a wide array of topics, from varying perspectives and across a range of populations;
- Survey provides an efficient way to collect large scale data from a large population;
- Survey results can potentially be generalised from a small numbers of samples to a larger population or a larger population can be studied by surveying a comparatively smaller sample of respondents;
- Survey data can be analysed in many different ways by using statistical analysis techniques;
- Survey data can be used as a source for secondary data analysis.

The intrinsic weaknesses of survey are (Chadwick et al. 1984, p102; Walter 2010, p154):

- Survey data collected at a specific time does not reflect the situation at any other time;
- Survey data may deviate from facts as the respondents are influenced by a range of social and external factors that are not disclosed;
- Survey cannot be used to test cause-and-effect relationships;
- Survey does not provide detailed insights;
- Survey can sometimes be comparatively expensive.

Despite general similarities there are many different types of survey and each has different advantages and disadvantages (Trochim 2006). The interview and the questionnaire are the two most common approaches to surveying any group and these can be further sub-divided (Chadwick et al. 1984, p100). Neuman (2012, p195) classified surveys into 4 categories: mail questionnaires, web surveys, telephone interviews; and face-to-face interviews. Several key features of these survey types are compared in Table 3-2.

Table 3-2: Types of Surveys and their Features
(Source: Adapted from Neuman (2012, p195)

	Types of Survey			
Features	**Mail Questionnaire**	**Web Survey**	**Telephone Interview**	**Face-to-Face Interview**
Administrative Issues				
Cost	Cheap	Cheapest	Moderate	Expensive
Speed	Slowest	Fastest	Fast	Slow to moderate
Length	Moderate	Moderate	Short	Longest
Response rate	Lowest	Moderate	Moderate	Highest
Research Control				
Visual observation	No	No	No	Yes
Success with Different Questions				
Open-ended Questions	Limited	Limited	Limited	Yes
Contingency questions	Limited	Yes	Yes	Yes
Complex questions	Limited	Yes	Limited	Yes
Sources of Bias				
Social desirability	Some	Some	Some	Most
Interviewer bias	None	None	Some	Most
Respondent's reading skill	Yes	Yes	No	No

Although it is most common for interview-based surveys to make use of a structured interview approach (Bryman 2004, p109), semi-structured interviews have also been employed as a data-gathering techniques in IS research surveys (Bawden et al. 2000; Sarshar & Isikdag 2004; Sittig et al. 2008). In a semi-structured interview the question list is more general than those typically found in structured-interviews and the researchers can vary the sequence of questions and ask further questions in response to the interviewees' replies (Bryman 2004, p113). Surveys employing semi-structured interviews, with a flexible and structured interview framework, still allow the researcher to collect both quantitative and qualitative data and to accrue comparable results for statistical analysis (Bawden et al. 2000; Sarshar & Isikdag 2004).

Since there are so many types of survey approach, it is critical to choose an appropriate survey type for a particular research project. However there are few standard rules to guide the selection procedure (Trochim 2006). Trochim (2006) provides a number of hints for researchers determining the type of survey to use.

1) Population issues

The population issues concern the size of the population and its literacy, languages, likely co-operation and geographic restrictions. Some of the questions that need to be considered include: Can the population be enumerated? Is the population literate? Are there language issues? Will the population cooperate? What are the geographic restrictions?

2) Sampling issues

The sampling issues concern the accessibility of actual contacts and response rate. Some of the questions that need to be considered include: What data is available? Can respondents be found? Who are the respondents? Can all members of the population be sampled? Are response rates likely to be a problem?

3) Question issues

The question issues concern the nature of the research questions which may affect the selection of survey type. Some of the questions that need to be considered include: What types of questions can be asked? How complex will the questions be? Will screening questions be needed? Can question sequence be controlled? Will lengthy questions be asked? Will long response scales be used?

4) Content issues

Content issues concern the respondents' understanding of the research topic and accessibility of the content that may be required. Some of the questions that need to be considered include: Can the respondents be expected to know about the issue? Will respondents need to consult records?

5) Bias issues

Bias issues concern the ways to minimise bias raised during the survey. Some of the questions that need to be considered include: Can social desirability be avoided? Can interviewer distortion and subversion be controlled? Can false respondents be avoided?

6) Administrative issues

Administrative issues concerns the feasibility of a survey in terms of available funding, facilities, time and personnel.

All these issues need to be taken into account in deciding whether survey is the correct approach for any particular research project.

Given that this research is an exploratory research focusing on Web 2.0 use in the diversified agri-food industry, comparable and generalizable results can help to provide an overview where survey research method played an important role (Neuman 2012, p173; Pinsonneault & Kraemer 1993).

In order to understand the primary producers' Web 2.0 acceptance, it is necessary to gather some qualitative data such as their opinions about the adoption and reasons of their words (Bryman 2004, p287). Although survey is widely cited as a research method to gather quantitative data, by employing semi-structure interviews it still allow the investigator to gather qualitative data (Bawden et al. 2000; Sarshar & Isikdag 2004). Thus survey is deemed an appropriate research method for this research.

Survey can be further divided into different types, Neuman (2012, p195) categorises four main types comprising: mail questionnaire, web survey, telephone interview and face-to-face interview. In selection of survey types, the different features of those survey types summarised by Neuman (2012, p195) and the hints suggested by (Trochim 2006) are considered.

Like many other researches, response rate is one of the primary concerns. Since primary producers were considered to have comparatively poor literacy and computer skill mail questionnaire and web survey were deemed unsuitable. Moreover lack of interaction in mail questionnaire and web survey was the intrinsic weakness for their employment for this research which requires qualitative data.

Although face-to-face interview is expensive it has a range of strength over its counterparts. These include response rate, success with different questions and low requirement for respondent's reading skill. In supplement, telephone interview offers a compromised solution where face-to-face interview is deemed inappropriate. These situations include too costly or time consuming to visit interviewees when they are willing to be interviewed over telephone.

3.4.2 CASE STUDY

Case study emphasises the collection of in-depth qualitative data from a small number of participants (Gable 1994). Case study is appropriate for two particular types of problems: firstly, where the research area is in its infancy and the relevant theories are formative; and, secondly, where the research heavily relies on the user's own experience and contextual actions (Pinsonneault & Kraemer 1993).

Benbasat (1987) summarised 11 key characteristics of case studies

- Phenomenon is examined in a natural setting;
- A range of data collection techniques are employed;
- A small number of entities (person, group, or organization) is examined;
- Detailed information and insight are gained;
- Are more suitable for the exploration, classification and hypothesis development stages of the knowledge building process, where receptive investigator is preferable;
- Data collection process is less structured;
- Set of independent and dependent variables may not be specified in advance;
- The quality of results depends on the analytical and integrative skill of the investigator;
- More freedom for the changes in site selection and data collection methods;
- Competent to investigate "why" and "how" questions with considerable amount of qualitative information;
- Contemporary events are the focus.

Case study strategy is appropriate for Information Systems research for three reasons: it is possible for the researcher to generate findings and propose theories upon investigation of practical work; this approach permits the researcher to answer qualitative questions such as “how” and “why” which have complex natures and processes; and finally, the topic enables exploratory investigation of the on-going emergence of new topics in Information Systems (Benbasat et al. 1987). The weaknesses of case study are the difficulties of achieving controlled observation, controlled deduction, replicative study and generalisable results (Lee

1989), which are almost exactly the opposite of survey's strengths and weaknesses, as shown in Table 3-3 (Gable 1994).

Table 3-3: Relative Strengths of Case Study and Survey Methods (Adapted from Gable (1994))

	Case Study	Survey
Controllability	Low	Medium
Deductability	Low	Medium
Repeatability	Low	Medium
Generalisability	Low	High
Discoverability (explorability)	High	Medium
Representability (potential model complexity)	High	Medium

Case study has a number of characteristics summarised by Benbasat (1987) that are suitable for this research. For example, 'a small number of entities is examined' could potentially provide time and cost efficient approach for the investigator, which is important for the PhD project with limited resource; 'detailed information and insight are gained' enables the investigator to gain adequate information and sufficient understanding about the diversified agri-food supply chain; 'competent to investigate "why" and "how" questions with considerable amount of qualitative information' enables the investigator to gain the opinions about the Web 2.0 adoption from the interviewees and the reasons of their opinion such as "What is the reason for you to adopt Web 2.0" and "Why do you think the reason is important for the adoption?". Case study is also suitable for contemporary events such as Web 2.0 application in SCM.

However, this exploratory research aiming to gather an overview and generalizable results about the Web 2.0 application for SCM in a range of agri-food supply chains in Tasmania. Lack of generalizability is the intrinsic weakness of case study (Gable 1994). Furthermore low controllability (Gable 1994) is a critical challenge for an investigator without local experience. Thus case study is not suitable for this research, instead, survey employing semi-structured interviews that is discussed in the previous section is deemed more appropriate.

3.4.3 RAPID APPRAISAL

Rapid Appraisal (RA) can be broadly described as *"any systematic activity designed to draw inferences, conclusions, hypotheses or assessments, including acquisition of new information within a limited period of time"* (Grandstaff & Grandstaff 1987). RA is an ethnographic research method originating from Rapid Rural Appraisal (RRA), an approach originally designed to cater specifically for the needs of researchers working in rural and remote environments over a limited timeframe, to overcome the time-consuming and costly weaknesses of traditional methods (Chambers 1994; Wilkins et al. 2004)

The successful introduction of RA into IS research conducted in remote and rural areas originally resulted from its ability to gather complex data from large groups of people in thinly-settled areas (Crawford 1997). The key principles of RA supporting this ability are, according to Wilkins, Swatman & Castleman (2004):

- Appropriate imprecision and optimal ignorance: optimal ignorance refers to minimizing the data gathering scale to what is actually needed, while appropriate imprecision encourages researchers to achieve modest accuracy in data gathering for practical purposes. Appropriate impression and optimal ignorance are subjective issues arising from the researchers' decisions made on the spot. Competent RA researchers need to equip themselves with superior observing, listening and learning skills;

- Triangulation: refers to retrieving more than one type of information source as well as gathering data from a number of people for validation. Triangulation can also apply to researchers from a variety of disciplines examining the same data source to provide more than a single interpretation of those data. Data triangulation, participant triangulation and investigator triangulation help to improve the quality of research outcomes and to minimize the risk of bias and inaccurate reporting;

- Rapid and progressive learning and reflective practice: RA researchers are not required to follow a blueprint but to adapt their approaches and techniques through a learning process. RA is seen as an evolving and open system that makes good use of a variety of information acquired in the field which is progressively shaped into a final outcome. As already mentioned, semi-structured interviews, direct observation and interpretation-sharing are frequently adopted instruments for gathering data in RA, although there is no requirement to use any particular technique(s) and researchers can (and do) employ a wide variety of other methods;

- Strong researcher-community interaction: based on a fuller understanding of the community perspective than is available from traditional data gathering techniques, RA is designed to ensure that new activities and implementations suit the community's interests rather than purely individual needs;

- Sustained attention to context: to reduce the widening gap between research results and practical use, context and particular locations may be critical factors for RA research, because the solution ultimately recommended must be both viable and acceptable within the local context.

The principles and techniques of RA which make it particularly suitable for IS research, especially as a data-gathering solution, (Wilkins et al. 2004) include:

- RA's ability to integrate with other qualitative methods (e.g. case study and focus group) makes it particularly suitable for studying adoption and diffusion patterns in IS implementations, helping the researcher to define problems;

- RA's power of aggregate knowledge in that it encourages people to share their own opinion(s) regarding IS concerns. The overlapping feedback possible from RA data-gathering techniques mitigates the likelihood of inappropriate introduction of IS systems;

- RA's focus on context makes it particularly suitable for IS research questions of an exploratory nature, where context is critical to understanding an implementation; and

- RA's flexible use of method and adaption through learning, as well as its low-cost and time-efficient features, allow RA to investigate emerging new topics and dynamic areas of IS research where there is a shortage of existing revelatory case studies.

Although RA has a range of strength in gathering data in the rural environment it requires investigators to have sufficient or even superior field knowledge. This is an intrinsic challenge for the investigator intending to investigate different sub-sectors in the diversified agri-food supply chain as all of them have different features and operations. Thus RA is deemed inappropriate for this research.

3.4.4 JUSTIFICATION FOR THE SELECTED RESEARCH METHOD

All of these research methods have their own strengths and weaknesses but some of the weaknesses could be overcome or eliminated by employing appropriate strategies, approaches and data gathering techniques. However some have intrinsic weaknesses which made them unsuitable for this research project. Despite some weaknesses, survey, with the ability to gather broad and comparable data, was considered to be an appropriate research method for this research project for the following reasons.

Both case study and Rapid Appraisal have some intrinsic difficulties that would have been difficult to overcome in this research project. With case study, although it can generate in-depth information, there are possibly not adequate Web 2.0 users or even not sufficient interviewees with good understanding of Web 2.0 for us to conduct case studies. With respect to Rapid Appraisal, although it is tailored to rural study and is competent to overcome the time-consuming and costly nature of traditional methods (Wilkins et al. 2004), it requires intensive interpretation ability and excellent communication skill to achieve satisfactory outcomes. These requirements would have been a continual challenge for an international PhD student and therefore made RA less appropriate for this research project.

The weakness of survey could be overcome by employing appropriate data collection techniques and administration. Its primary weakness (referring to low response rate, inability to gather detailed information and reasons for the answers) can be overcome by employing semi-structured interview as a data gathering technique (Barriball & While 1994). Use of semi-structured interviews in surveys can explore subjective information such as perception and opinion, as well as gathering additional information in response to the replies that are deemed important. Surveys can also provide comparable results as the questions asked of each participant are identical, something which is impossible to achieve when using case study.

This discussion makes it clear that survey was a particularly appropriate research method for this research project. The use of a survey which employed semi-structured interviews as the data-gathering technique enabled the collection of a rich but still comparable body of data and, more importantly, enabled the collection of detailed information regarding participants' SCM operation and subjective opinions about Web 2.0 adoption. These data permitted the formulation of indicative results with possible generalisability concerning the application of

Web 2.0 in enhancing SMEs' agri-food supply chain management. Figure 3-2 depicts the position of the research method employed in this research project.

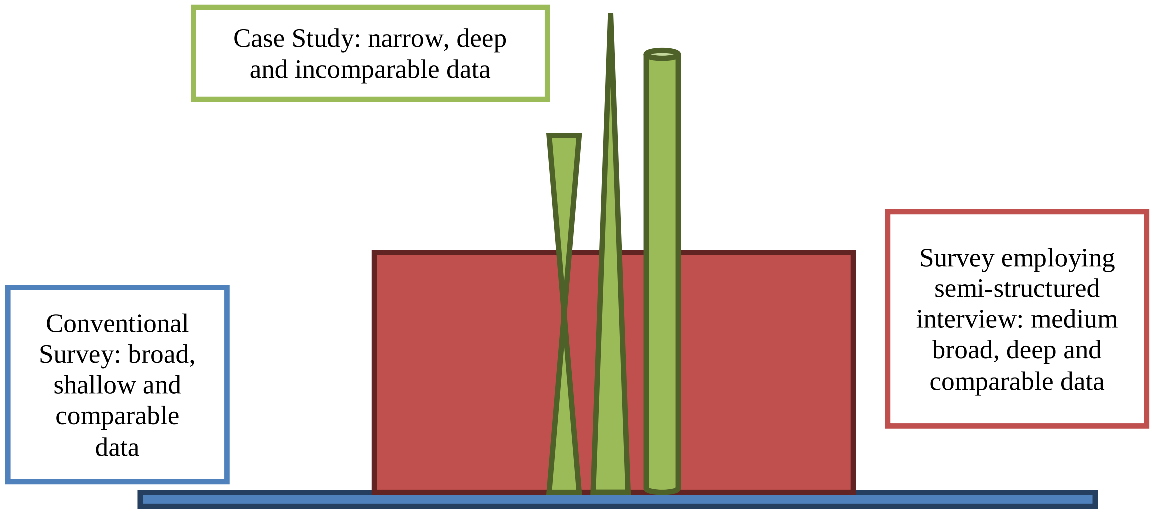

Figure 3-2: Comparison between Conventional Survey, Survey Employing Semi-Structured Interview and Case Study

3.5 RESEARCH DESIGN

It is essential to outline a research design before conducting a research project (Walter 2010, p32). A research design provides a framework guiding future data gathering and data analysis (Bryman 2004, p27). The research design aims to provide an answer for the main research questions, and in particular, one to three subsidiary research questions in each stage. For clarity, the overarching research question and the subsidiary research questions are re-introduced as below.

Overarching research question:

Can SMEs in the agri-food industry, especially primary producers, use Web 2.0 technologies to enhance their supply chain performance?

Subsidiary research questions (SRQs):

SRQ1: What evidence exists that SMEs in the agri-food sector can use Web 2.0 technology to link more efficiently with their supply chain?

SRQ2: What frameworks have been developed to explain the use of Web 2.0 technologies?

SRQ3: (How) are individual SMEs using ICT for their supply chain management?

SRQ4: What is the current state of agri-food SMEs' use of Web 2.0 in managing their agri-food supply chain?

SRQ5: What differences exist between each agri-food sub-sector in applying Web 2.0 technology to their supply chain?

SRQ6: How effective are Web 2.0-based approaches to supply chain management for Tasmanian agri-food SMEs

The structure of the research project is illustrated in Figure 3-3. The research project consisted of two stages: theoretical analysis and empirical research. The empirical research was further divided into three phases: overview gathering, detailed data gathering and data validation. Key informant interviews, survey and focus group were the primary data gathering techniques employed in those three phases respectively. In the sub-sections which follow, the various stages of the research design are discussed in more detail.

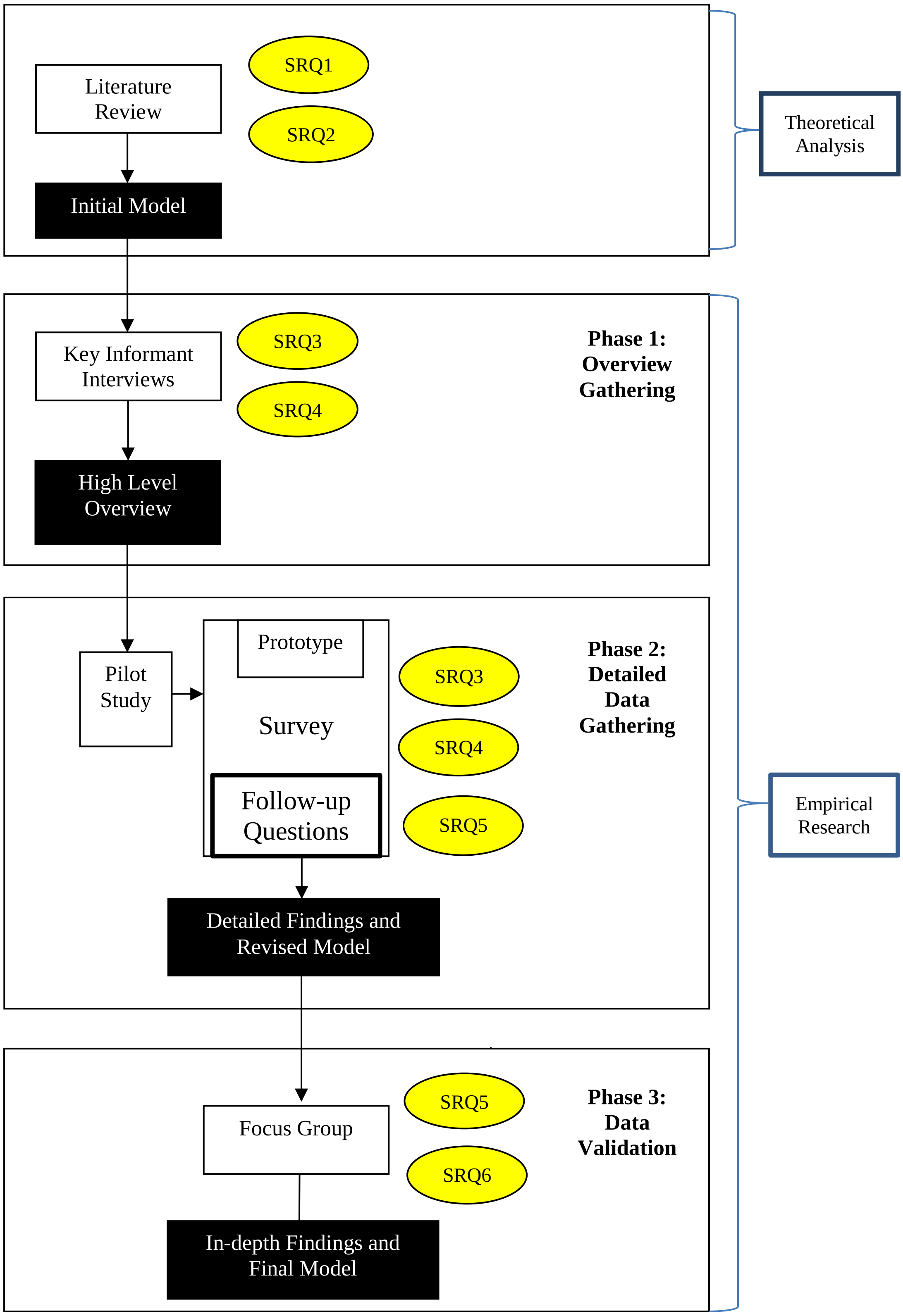

Figure 3-3: Research Design

3.5.1 THEORETICAL ANALYSIS

The initial theoretical analysis was conducted by means of a literature review, something which should always be conducted during the early stages of the research process (Neuman 2006, p111). A thorough literature review provides a sound foundation upon which researchers can build further study. This process is known as *"standing on the shoulders of giants"* (Fresch 2008) and is evidence of a comprehensive understanding of the proposed research and the avoidance of unintended duplication. Neuman (2006, p111) lists four aims of a literature review:

- To illustrate comprehensive understanding in a particular area and convince the reader of the importance of the research topic;
- To demonstrate the linkage between the proposed research topic and existing findings;
- To summarise previously related studies and point out the direction of the future study;
- To build on previous efforts and identify what limitations exist in them.

Neuman (2006) also identifies a number of appropriate sources for academic references, including: books, scholarly journal articles, dissertations, refereed conference proceedings and government documents or policy reports. Internet resources offer a supplementary source for researchers as the internet has revolutionized our ability to access research materials. In 'green field' studies, especially, online materials can supplement a shortage of officially published academic sources.

This literature review combined mature theories and a number of technology acceptance models sourced from widely cited publications with the latest online information published by recognised authors in the field of Web 2.0 to provide the preliminary theoretical model on which the subsequent empirical data gathering was based – and which it was designed to either confirm or modify. The literature review also covered topics relating to SMEs, agri-food industry, and agri-food supply chain management generally.

3.5.2 RESEARCH ETHICS APPROVALS

As with all social science research projects, it is necessary to obtain Human Research Ethics approval before any empirical data can be collected and, in Tasmania, such approval is obtained from the Human Research Ethics Committee (Tasmania) Network.

The empirical data collection process was approved by means of a single ethics application plus two amendments, all of which had the same Ethics Reference Number (H11309) and all of which were classified as minimal risk ethics applications. Two annual progress reviews were reported during the data gathering and analysis process. The ethics process is summarised in 'Table 3-4: Ethics Process'.

Table 3-4: Ethics Process

Document Types	Aim	Approval Data
Main ethics application	Obtain permissions to conduct key informant interviews and survey data gathering.	25/07/2010
Annual Review	Annual progress review for the period of July 2010 – July 2011.	21/10/2011
Annual Review	Annual progress review for the period of July 2011 – July 2012.	16/07/2012
Amendment	Obtain permission to conduct an additional research method – focus group – for the validation phase (this amendment was previewed in the original application)	19/11/2012
Amendment	Obtain permission to conduct a series of follow-up interviews predominately by email or telephone	11/12/2012

The first HRE application covered the initial two stages of data gathering: key informant interviews and the rapid appraisal survey. While it was originally envisaged that the survey would be undertaken by means of Rapid Appraisal techniques, the investigator's non-English speaking background made it more effective to make use of a survey utilising the same structured questionnaire as was developed for the Rapid Appraisal investigation. It is easier for a non-native speaker to handle one-on-one interviews than group interviews.

Since the majority of the survey interviewees were primary producers who did not have much time to spend on the interview, the survey interviews were kept as short as possible. As a result, following the survey data gathering, it was found that some detailed information, especially in terms of the reasons for particular answers, had been missed. An amendment to the ethics application was therefore designed to gather supplementary data. These interviews incorporated a series of follow-up questions which supplemented the original survey (and is discussed in Chapters 5 and 6).

The second ethics application amendment, which was anticipated and previewed in the original application, covered the use of focus group as a research method for the final stage of the data collection, to validate the data.

The HRE approval letter for the main ethics application is included in this thesis in Appendix B. As shown in the approval letter, the initial thesis title was 'Web 2.0 enabled integration of agricultural Small and Medium Enterprises with their food supply chain in Tasmania'. In order to reflect the actual study it has been refined to the existing one "Using Web 2.0 to enhance SME agri-food Supply Chain Management: a Tasmanian study".

3.5.3 EMPIRICAL RESEARCH

The empirical research built on the findings of the theoretical analysis and was made up of three phases: overview gathering, detailed data analysis; and data validation. The findings in each phase were used to amend the research model.

Truly effective research frequently makes use of the concept of triangulation which Denzin (1978, p291) broadly defines as *"the combination of methodologies in the study of the same phenomenon"*. To introduce different types of triangulation, Neuman (2006, p149) defines this concept as *"the idea that looking at something from multiple points of view improves accuracy"*. There are several types of triangulation (Neuman 2006), including:

- Triangulation of measure(ment)s
- Triangulation of observers
- Triangulation of theory
- Triangulation of method

The effectiveness of triangulation rests on the premise that the disadvantage of any single research approach may be minimised and eliminated by taking advantage of multiple approaches (Jick 1979): the strengths of one approach can help to outweigh (or even obviate) the disadvantages of another approach: for example, surveys provide broad but shallow data, whereas interviews usually provide deep but more narrowly focused findings. These two approaches in combination can offer both the breadth necessary for at least partial generalisability, as well as offering explanations for anomalous or apparently contradictory findings. Triangulation can therefore enhance a researcher's confidence in his/her results; assist in discovering bias and deviations in research; enable theory integration; and, finally, test competing theories (Jick 1979).

This project used triangulation of measurements and triangulation of method to ensure that findings were informed by a wide and acceptably representative group of participants – and that those findings were validated by a second round of enquiry.

3.5.3.1 OVERVIEW GATHERING

In an area where little research has been undertaken and where academic theory is still limited, the starting point was to interview key informants and experts from the field. In order to build a broad picture of ICT use in agri-food supply chains, a series of interviews with experts in a number of agri-food sectors was carried out in the Australian State of Tasmania. The focus of the interviews was the primary producer end of the agri-food supply chains, with the interviews concentrating attention mainly on farmers and fishermen. However, information was also sought regarding distributors and processing companies that dealt directly with farmers and producers. As already mentioned, the sectors investigated were chosen due to their importance in the Tasmanian primary industry and with a view to gaining insights into a diverse set of sectors. The sectors investigated were seafood, dairy, fruit, vegetable farming and livestock.

In all ten interviews were completed, with each interview taking between 1 – 1.5 hours. The interviews were transcribed and were analysed using direct thematic analysis (Braun & Clarke 2006; Fereday & Muir-Cochrane 2008). The findings were then written up and confirmed with the interviewees.

These 'Key Informant Interviews' can provide an overview of the research area, potentially saving many months of work on the researcher's part (Krueger 2006). Key Informant Interviews offer a better starting point for researchers to tap into a field and discover unanticipated relationships than do many of the alternative techniques such as survey or 'traditional' case studies (Beebe 1995). This offers real benefits to a researcher who lacks background knowledge of the field and can help to enable smooth and efficient data gathering at the grassroots level over a shorter period of time than would otherwise be possible (Wilkins et al. 2004). In particular, the key informants in the agri-food supply chain were not only able to provide important information about the system, but could also clarify their communication methods with the major grocery chains and other food retailers within the Australian context, as well as suggesting other potential participants in the research project.

3.5.3.2 DETAILED INFORMATION GATHERING

Following the high level overview obtained from the key informants in the agri-food field, the research began with a small-scale preliminary study of the Tasmanian agri-food industry.

Since the project was exploratory research, it was necessary to obtain an overview of ICT, especially Web 2.0, application in SCM in Tasmania by gathering predominantly broad and objective quantitative data. For the sake of credibility and reliability, the quantitative data was supplemented by the qualitative data which provided richer insights into the topic. Both quantitative and qualitative data acquisition were achieved by the following six data collection techniques: questionnaires, interviews, focus groups, tests, observations; and unobtrusive measures (Teddlie & Tashakkori 2009, pp. 217-247).

These data gathering techniques have different features:

- A questionnaire is a self reporting data collection instrument that is constructed by the researcher(s), and is filled out by research paricipants (Tashakkori & Teddlie 2003, p. 303). It provides an inexpensive way to gather data, and an easy way to analyse closed-end items (Tashakkori & Teddlie 2003, p. 306)

- An interview is a one-to-one interaction where the research interviewee answers questions asked by the researcher (Teddlie & Tashakkori 2009, p. 229)
- Focus group refers to a nominal group discussion led by a moderator who can tap genuine feelings and issue about the topic without interference (Lichtenstein & Swatman 2003). Focus groups allow key stakeholders to exchange, explore and test ideas, feedback, brainstorming, and discovery, by which the moderator is able to generate valuable qualitative research information (Lichtenstein & Swatman 2003)
- Tests are techniques used to access intelligence, ability, or measure attitudes, personality and performance (Tashakkori & Teddlie 2003, p. 310; Teddlie & Tashakkori 2009)
- Observation could be defined as "the recording of units of interaction occuring in a defined social situation based on visual examination or inspection of that situation" (Teddlie & Tashakkori 2009, p. 218). Observation can help researchers to inspect interviewees' actual behaviors or facts that are sometimes different from what they have been told (Tashakkori & Teddlie 2003, p. 319)
- Unobtrusive measures are investigations without interfering with the individuals being studied which eliminate deviation caused by interviewees' suspicions or distrustfulness during the interview (Teddlie & Tashakkori 2009).

Considering the limited time and resources available for the research project, it was vital to employ appropriate data gathering techniques in terms of applicability, cost-effectiveness, efficiency, reliability and credibility. Each of these six data collection techniques has its advantages and weaknesses, but some of them have intrinsic drawbacks when being employed for survey.

Many researchers believe questionnaire and interview are the two most suitable data-gathering technique used in survey (Chadwick et al. 1984, p100; Neuman 2012, p195). Questionnaire can be used to collect broad data, but its low response rate (Teddlie & Tashakkori 2009, p. 239), especially while surveying farmers, is a constant challenge (Pennings et al. 2002). As compared with questionniare, interviews overcome the weakness of lack of immediate interaction, and allow researchers to clarify unclear questions and ask for an explanation of vague answers (Teddlie & Tashakkori 2009, p. 310). Interviews, despite being time-consuming and possibly expensive, improve the quality of response, and more importantly, can probably attain high response rates (Tashakkori & Teddlie 2003, p. 308).

Recent evidence supports the use of questionnaires or interviews, or a mix of these approaches, to gather data in an agri-food supply chain study (Ameseder et al. 2009; Manthou et al. 2005; Matopoulos, Vlachopoulou & Manthou 2007; Matopoulos et al. 2009). There are two schools of thought regarding the mixing of these data collection techniques, comprising intra-method mixing and inter-method mixing (Tashakkori & Teddlie 2003, p. 298). Intra-method mixing refers to sequential or concurrent use of a single method including both qualitative and quantitative components. Inter-method mixing is defined as the sequential or concurrent mixing of two or more data collection methods (Tashakkori & Teddlie 2003, p. 298).

The low response rate is a constant challenge in the use of questionnaires, especially when surveying farmers (Pennings et al. 2002). Interviews, particularly employment of in-person semi-structured interviews based on a questionnaire, have the potential to overcome the intrinsic weakness of the low response rate of the questionnaire method, and retain the responses as a structured or systematic set of survey data.

For the sake of effectiveness, it was decided that the researcher would visit the interviewees in person and conduct semi-structured interviews based on a structured questionnaire. To visualise the Web 2.0 concept and improve the understanding of Web 2.0 enabled SCM, the researcher also made use on site of a prototype Web 2.0 solution based on Facebook and Google Drive (formerly named Google Doc). This was partly because of the accessibility of these two technologies for both researcher and participants, as well as because these popular social networking and collaborative sites make use of a variety of typical Web 2.0 features. The prototype permitted participants to see how they might use Web 2.0 technologies to communicate more effectively with their supply chain, while allowing them a ‘safe’ environment in which to experience the Web 2.0 phenomenon without having to risk their real business.

The researcher closely monitored participants’ use of the prototype, their satisfaction with the possibilities offered by Web 2.0 and their opinions concerning whether such an approach holds real potential for their supply chain environment. Given that the number of interviewees was limited, all the data were analysed and presented by descriptive analysis.

3.5.3.3 DATA VALIDATION

In stage 3, once the empirical data had been gathered and the preliminary theoretical model had been verified and modified to reflect the data, it was imperative to validate the findings as well as to supplement the extensive survey findings with additional findings by conducting a focus group.

Focus group is a nominal group technique that is designed to obtain outcomes of discussion focusing on particular topics (Tashakkori & Teddlie 2003, p. 308). This approach falls somewhere between participant observation and in-depth interviews (Morgan 1996). Focus groups can provide an effective platform for generating and assembling the views and knowledge of a variety of expert stakeholders (Lichtenstein & Swatman 2003).

Focus groups also play an important role in validating data and providing supplementary information for social science research projects. In the case of this project, the outcomes of the key informant interviews provided overviews of the four types of agri-food supply chains under investigation. The survey interviews provided the necessary detail concerning relationships common to the primary producers who represented their sectors, thus enabling the formulation of more general findings (Gable 1994). The survey approach also allowed the discovery of the common relationships across the sampling organizations, and the generalization of the findings (Gable 1994). Focus groups, however, are very suitable for obtaining in-depth information and playing a validating role in e-business research (Lichtenstein & Swatman 2003). The sequential application of key informant interview, survey and focus group research methods enabled the development of in-depth and reliable findings – with some limited generalisability.

3.6 SUMMARY

This chapter has reviewed the main research paradigms, research taxonomies and research methods used in information system research; and provided a justification of the selection of the particular combination of methods adopted. Based on these settings, the research design used to answer the main research question as to whether or how Web 2.0 technologies can enhance SME's agri-food supply chain management was then outlined.

For the sake of clarity the research paradigms, research taxonomies, research methods and data gathering techniques have been summarised as below.

- Research paradigm: postitivist and interpretivist;
- Research taxonomies: exploratory, both quantitative and qualitative, inductive;
- Research methods: survey;
- Data collection techniques: key informant interviews, semi-structured interviews based on questionnaires and focus groups.

The first stage of the empirical research will be presented in the next chapter.

Chapter 4

Key Informant Interviews

This chapter is based on a publication presented at the International Conference on Internet Technologies & Society (ITS 2012) Perth, Australia (Liao et al. 2012)

4.1 INTRODUCTION

In the last chapter the design of the research project and justification of the selected research method have been provided. Considering the diversity and unique characteristics of the agriculture and seafood industry in Tasmania, it was necessary to acquire sufficient knowledge of the various agri-food supply chains existing in the State before developing the questionnaire and surveying primary producers. The Key Informant Interviews were therefore designed to gain an overview of the Tasmanian seafood industry and the use of Information Communication Technology (ICT) in the agri-food supply chains selected, with a view to understanding the current state of Web 2.0 use. Figure 4-1 highlights the stage of the research project described in this Chapter.

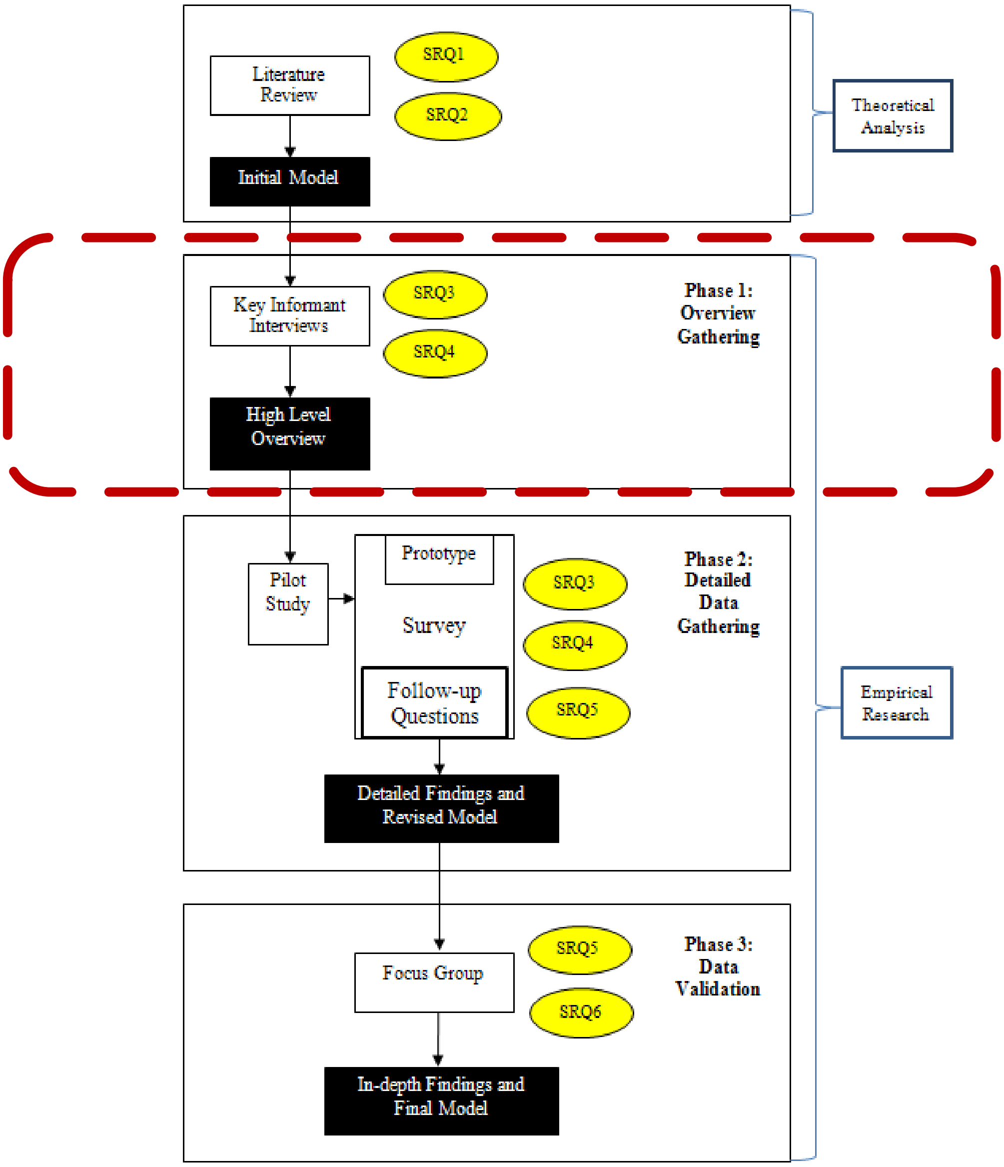

Figure 4-1: The Stage Described in Chapter 4

4.2 OVERVIEW OF THE KEY INFORMANT INTERVIEW

The interviews predominantly took place face-to-face, but video conference and telephone were also used when face-to-face interviews were not possible, such as when interviewees and interviewers were separated by long distances. Two types of senior informants were recruited: informants with research backgrounds who were aware of activities worldwide; and informants with an industry background in the seafood, dairy, fruit & vegetable or livestock sub-sectors who had expert knowledge of the Tasmanian situation. Their knowledge was complementary and provided overviews of each sub-sector from two quite different perspectives. In total, ten key informant interviews were held. These not only provided overviews of the various supply chains but also clarified their communication methods and suggested other potential participants in the research project from that sector. Interview 9 contributed to the pilot of the survey questionnaire and Interview 10 included the filling of the questionnaire which was also included as a survey interview. The profiles of these ten interviews are summarised in Table 4-1.

Table 4-1: Key Informant's Profiles

Interviews	Sub-sectors	Interviewees	Backgrounds	Other Contributions
Interview 1	Seafood	EXS1 and EXS2	Research	
Interview 2	Seafood	EXS3	Industry	
Interview 3	Seafood	EXS4	Industry	
Interview 4	Dairy	EXD1 and EXD2	Research	
Interview 5	Dairy	EXD3 and EXD4	Industry	
Interview 6	Fruit and Vegetable	EXV1	Research	
Interview 7	Fruit and Vegetable	EXV2	Research and Industry	
Interview 8	Fruit and Vegetable	EXV3, EXV4 and EXV5	Industry	
Interview 9	Livestock	EXL1	Industry	Piloted survey questionnaire
Interview 10	Livestock	M2	Industry and Research	Participated in Survey

This chapter presents summaries of the ten interviews, classified by sub-sector. In each sub-sector, the consolidated findings of the interviews are used as the basis for the creation of the supply chain diagrams. The Chapter concludes with a tentative and general overview of the agri-food supply chain in Tasmania by way of an answer to SRQ3 and SRQ4.

Given that computers and IT technologies are ubiquitous, the ICT used for SCM that are discussed in the empirical research are referred but not restrict to those forms listed Table 4-2.

Table 4-2: Types of ICT included in the Empirical Research

Email
Web-based supply chain management platform (e.g. eBay)
Particular software designed for supply chain management purpose (e.g. ERP)
Electronic Data Interchange (EDI)
Web EDI
Shared Electronic Documents
Other ICT that can potentially be used for supply chain management (e.g. Facebook and Apps)

Matopoulos et al. (2007) summarised the activities in an agri-food supply chain comprising:

- procurement;
- inventory management;
- product design and new product development;
- manufacturing (planning);
- order processing;
- transportation/distribution;
- sales;
- demand management; and
- customer service.

For this exploratory research, any ICT that can potentially enhance any of the above supply chain activities could be considered as the ICT use for SCM.

4.3 KEY INFORMANT INTERVIEWS IN SEAFOOD SUB-SECTOR

Three interviews focusing on the seafood sub-sector were arranged and four key informants were invited to participate in the interviews, including: two specialists from the University of Tasmania in interview 1; one director of the Tasmanian Seafood Association in interview 2; and an IT manager from a Tasmanian aquaculture company in interview 3. This combination of informants with research, industrial and wild catch / aquaculture backgrounds provided a good coverage of knowledge of the industry.

4.3.1 TASMANIAN SEAFOOD SUPPLY CHAIN DESCRIBED BY KEY INFORMANTS

The Tasmanian seafood industry, particularly the commercial fishery comprising both wild catch and aquaculture, is export oriented. Wild catch volume has remained constant over the past decade; however, aquaculture has grown rapidly. Although wild catch production is flat, this sub-sector makes above average profits, typically with very high rates of return, as production is constrained by limited natural resources. By comparison, the aquaculture business, which has no constraints on seafood production quantity, has increased its production levels over the past decade yet makes only a ‘normal’ profit.

Profit levels are about 80% for wild catch abalone and 30% for wild catch southern rock lobster (crayfish). The wild catch abalone business revenue in 2010 was approximately $100 million, and abalone was selling at A$50/kg with a harvesting cost of only A$6/kg. In the same year, farmed salmon, with an annual turnover of A$300 million, made only A$20 million profit, due to the high cost of farming.

Three of the most profitable seafood products are southern rock lobster, abalone and salmon. Wild catch southern rock lobster and abalone provide the bulk of that industry, while farmed salmon is dominant within aquaculture. Both the wild catch and aquaculture operations produce high-quality product and are profitable; although their supply chains differ in a number of significant ways. Table 4-3 compares characteristics of the wild catch and aquaculture supply chains.

Table 4-3: Comparison of Wild Catch and Aquaculture Supply Chains

	Wild Catch	**Aquaculture**
Size of players	Individual or small business	Medium to large companies
Typical products	Southern rock lobster and abalone	Salmon
Production	Constrained by natural supply and under the quota system	Not constrained
Quota	Has quota	Does NOT have quota
Concentration	Large processors dominated	Not concentrated
ICT use	Limited	Extensive

One critical difference between wild catch and aquaculture is the quota system for wild catch which is important for the sustainability of the sub-sector depending on natural supplies. Profits are not evenly distributed among supply chain members under the quota system. Processors, contractors and some fishermen holding quotas gain greater profits than fishermen who need to rent quotas when their own quotas are exhausted. The quota yield has also changed over time. For example, the market for quota assets sets the asset price given a fixed level of earnings (and thus sets the yield). A quota unit for lobster generated A$1,300 per annum of rent in 2011. If these units trade at A$13,000 then the yield is 10%. If they trade at A$26,000 then the yield is 5%.

The wild catch supply chain is dominated by small businesses. Southern rock lobster and abalone are the two key products and are highly export oriented, with around 95% of product being exported to China where customers are prepared to pay higher prices than domestic consumers. In the lobster sub-sector, there are 220 fishermen, 6 significant processors (all largely focused on the Chinese market) and 44 smaller processors dealing with both overseas and domestic markets. In the abalone sub-sector there are about 300 fishermen and 42 processors, with 2,600 tonnes of abalone being caught and processed each year. The concentration of the abalone supply chain, like the southern rock lobster supply chain, is considerable with one very large and six large processors handling about 90% of the product. Their processing activities are similar and relatively simple, but some value-added processes (primarily canning and drying) occur in the abalone sub-sector.

In the wild catch supply chain some seafood companies operate an integrated supply chain from fishing to dining. Mures Tasmania Pty Ltd is a typical example of this kind of operation. Mures uses its own vessel to fish and the catch is processed in its own factory and then sold through a range of channels such as Mures restaurants, retail outlets, and some supermarkets.

The aquaculture industry, as indicated above, is characterised by medium-sized companies with highly professional ICT departments and advanced use of ICT systems including supply chain systems.

The situation regarding wild catch is somewhat different. Although fishermen have adequate ICT and technologies for catching fish, there is limited ICT use in their supply chain management. The reasons are twofold; the culture of secrecy and lack of suitable ICT systems.

Focusing first on the general characteristics of the wild catch supply chain, it is apparent that, overall, trust tends to be low between industry participants, and ‘keeping things secret’ is part of the culture in this sector. This lack of trust is evidenced by the fishermen’s reluctance to share their knowledge of, for example, good fishing spots in order to prevent head-to-head competition. There is also a lack of trust between fishermen and seafood processors. In particular, processors do not wish overseas buyers to make direct contact with fishermen as this might eliminate them as middlemen. Further, market information such as beach prices, market demands and retail prices are not shared.

The general culture of secrecy and lack of information-sharing tends to restrict the role of ICT in the wild catch subsector. This is particularly the case regarding systems like those reportedly used by European fisherman (Chauvin et al. 2010) for locating and managing the catch to optimise sales, since such systems rely on information sharing. Despite the apparently limited role of ICT in the Tasmanian wild catch sub-sector, there is Internet access via satellite on boats. However, fishermen generally limit its use to weather reports and searching on Google for such things as market price information. There do not seem to be any efficient and well-designed systems providing, for example, dashboards of price and market information, despite the fact that such systems could be useful. Instead, much communication quoting, for example, the beach price of particular fish, is conducted over the radio. Web 2.0 technology and systems, though familiar to participants, were not being widely used when the participants were interviewed.

The information exchange between fishermen and the government is no better, with a lag of two or more months before fishermen pass on mandated information to government via a paper base.

4.3.2 TASMANIAN SEAFOOD SUPPLY CHAIN DIAGRAMS

Based on the above information, the businesses and supply chains in the seafood sub-sector are still diversified and therefore it was necessary to focus on the typical seafood supply chains that most suited the project. Among a range of seafood supply chains that were identified, the southern rock lobster supply chain and the abalone supply chain are described here. The other supply chains in seafood sub-sector were trimmed for two reasons. Firstly, a significant portion of the interviews addressed the southern rock lobster and abalone supply chain as they are two of the most valuable products in Tasmania. Secondly, the aquaculture business was a medium or even large sized company, and this is beyond the focus of this research project. Although the findings from Interview 3 are useful and interesting they are not suitable for validating the research model as its operation is significantly different to the small and family businesses which are the focus of this study.

The southern rock lobster supply chain and the abalone supply chain in Tasmania are displayed in Figure 4-2 and Figure 4-3.

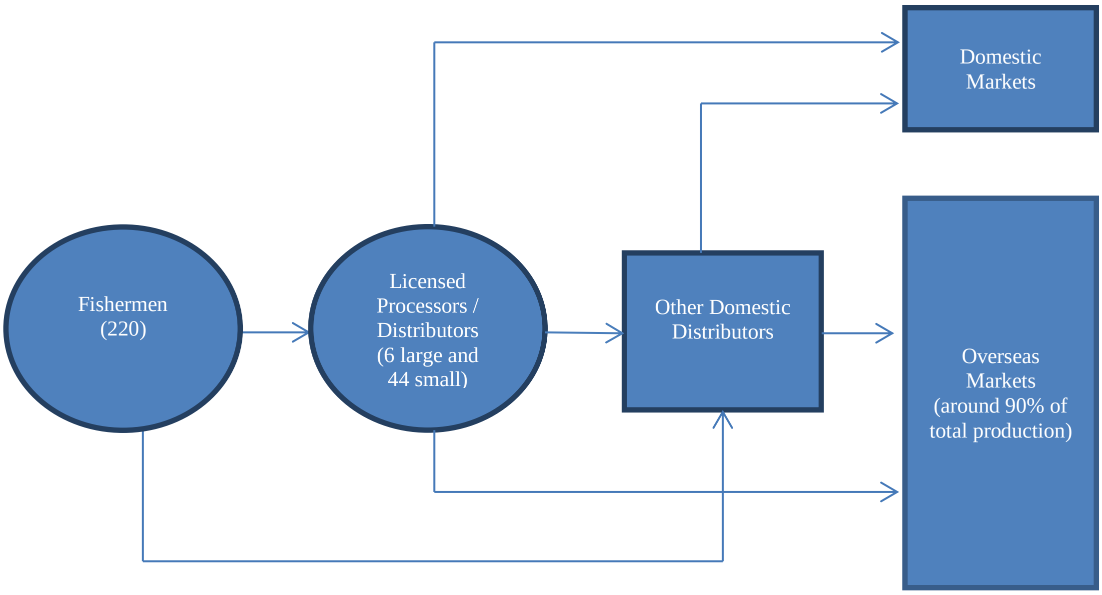

Figure 4-2: The Southern Rock Lobster Supply Chain in Tasmania

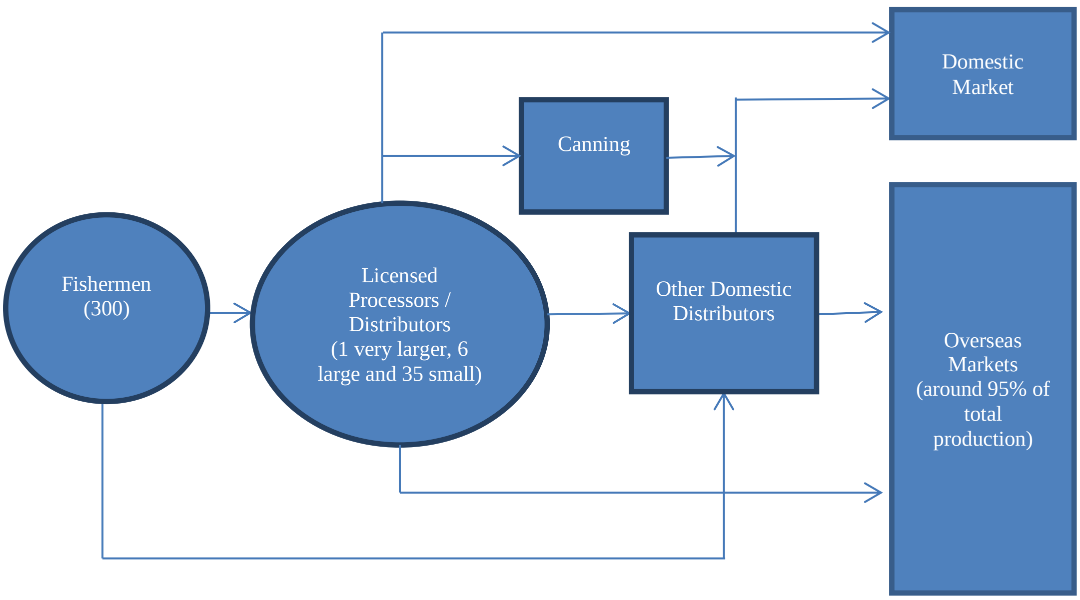

Figure 4-3: The Abalone supply chain in Tasmania

4.4 KEY INFORMANT INTERVIEWS IN DAIRY SUB-SECTOR

Four informants participated in the two interviews about the dairy industry. In particular, a video conference with two dairy researchers EXD1 and EXD2 from the Tasmanian

Institution of Agriculture (TIA) at the Cradle Coast Campus of the University of Tasmania was held as Interview 3 in 2010. EXD3 and EXD4 (both with industry backgrounds) were recruited to participate in interview 4 in 2011.

4.4.1 TASMANIAN DAIRY SUPPLY CHAIN DESCRIBED BY KEY INFORMANTS

There are approximately 450 dairy farms in Tasmania, most of them located in northern Tasmania. These farms carry herd sizes ranging from 35 to 2500+ cows, with the average herd size being approximately 300 cows. In total, 700 million litres of milk are produced in Tasmania each year. Raw milk is supplied to over 30 processors with the majority of dairy farms supplying only one processor. The farmers' work stops at the farm gates once the buyers collect their milk. Raw milk is further processed in or outside Tasmania and made into a variety of products such as fresh milk, milk powder, butter, cheese, and yogurt etc. These dairy products are then supplied to retailers within the state, but mostly they are exported to mainland Australia and worldwide. Due to significant and increasing concentration in the dairy supply chain over the years, three large processors now dominate supply chain interactions with farmers: Fonterra, Lion Nathan National Foods (previously National Foods) and Kraft Foods Australia (previously Cadbury). These large processors sell a variety of dairy products to the major supermarket retailers who take a significant percentage of their output. There are also a few small and medium-size processors which are quite well known in Tasmania and not only process their own milk but produce a range of dairy products and manage the marketing issues themselves, selling on to local restaurants, health stores and other small retailers or buying chains. Some of the small processors also export a range of dairy products both to mainland Australia and worldwide.

Tasmanian dairy farmers are under great pressure due to low returns, increasing costs, increasing requirements, competition from overseas rivals and lack of government assistance. Some of the pressure is due to low farm-gate prices imposed by the dominant processors, who in turn are facing similar pressures from the powerful supermarket retailers. Compounding the problems associated with such low prices are the increasing costs of farm inputs such as labour. Whilst the gate price of raw milk has trended up over time (see Figure 4-4), the cost of production and living has risen significantly over the past decade, resulting in fluctuating annual operating profits and Returns on Assets.

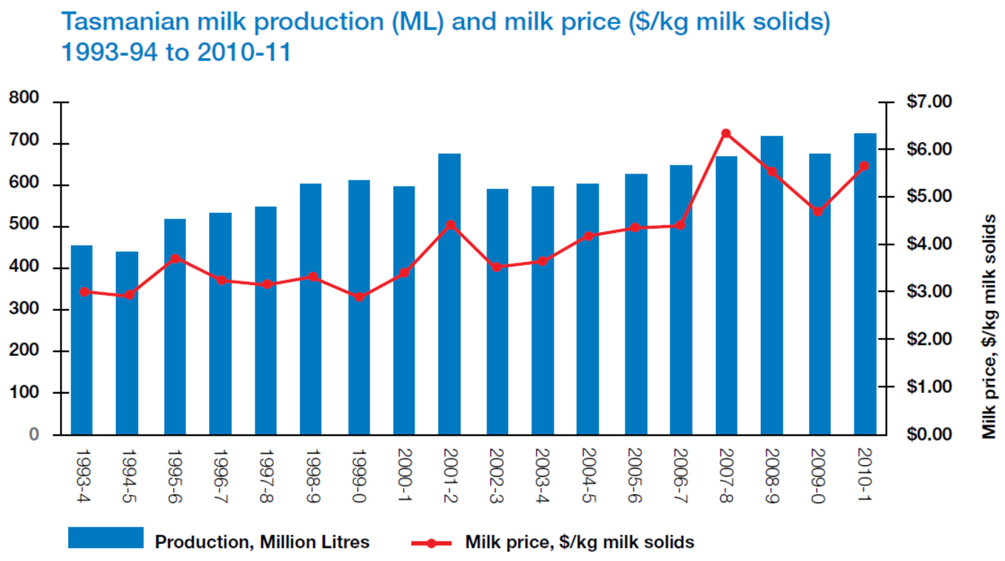

Figure 4-4: Tasmania Milk Production and Milk Price 1993-94 to 2010-11 (Source: www.dairytas.com.au)

Increasing requirements for traceability, animal welfare and environmental standards from customers, especially in mature markets such as Europe, have been passed on by large retailers and created additional burdens on dairy farmers. However, some farmers were undertaking farm expansion. A consequence of this was their difficulties in managing the animal welfare and environmental issues in those expanding farms. Overseas rivals, especially in developing countries, can supply cheaper milk by leveraging their low costs of labour and acquiring larger and cheaper areas of land. The difficulties of dairy farmers in Tasmania have not attracted as much attention from the government as in New Zealand, since the dairy industry in Tasmania is less significant to the economy compared to that in New Zealand.

These compound pressures have caused some farmers to begin to look outside the traditional supply chain dominated by the large processors and supermarkets but, as yet, successful alternatives such as co-operation with small alternative processors in niche markets such as 'organic' dairy products is very limited and, more importantly, continuity of collaboration has not been easy to achieve.

Although Tasmanian dairy farmers are, in general, discontented with the existing situation, they are less proactive towards establishing collaboration with other local farmers, processors and associations to overcome the difficulties as compared with their counterparts in other developed countries such as New Zealand and the U.S. In New Zealand, producers with strong bargaining power have started to establish cooperatives; in particular, to build their own factories and supply their own products to markets. By way of illustration, a story related to the changed attitude of cooperation among American dairy farmers was told by EXD2. About twenty years ago, EXD2 attended a meeting held by local farmers in response to the announcement made by the government regarding a subsidy cut to cheese and butter products in the United States. There were many farmers complaining about the cut and its consequence of requiring farmers to manage their sales and marketing. The farmers said:

> *"It is not our business, we are in the business of producing milk and we are not trying to sell. It is up to the processors."*

However things had changed dramatically when EXD2 revisited the region ten years later. The farmers had become very pro-active in promoting their dairy products by holding many events such as yogurt competitions, ice cream competitions, and farm exhibitions. Moreover the local farmer associations were working with farmers to explore overseas markets and more niche-type markets.

While it might seem likely that the cost and price pressures as well as local collaboration mentioned above would have driven serious ICT adoption and use, this does not seem to have occurred, at least not in dairy supply chain operations to date. There are different degrees of ICT use on dairy farms. Some dairy farmers are still using pen and paper (or blackboard in the milking shed) to record data, while others have applied ICT for a considerable amount of applications such as financial & planning systems and herd management systems (mainly for record keeping related to herd health testing issues). There is also considerable use of the Internet for online information searches with the occasional online purchase being transacted. Further, there has recently been considerable interest, and some investment and implementation, in ICT-based robotic milking systems. However, the serious use of ICTs in efficient ICT-based supply chain systems is simply not present. This is partly because of the simple nature of the downstream supply chain for dairy farmers, but it is also due, in part at least, to the poor telecommunication infrastructure, the lack of well-publicised and easy-to-use applications and lack of suitable devices that can be accessed on site for the busy working dairy farmers. It is interesting, in this context, to note that despite the rapidly increasing use by dairy farmers and their families of Web 2.0 applications such as Facebook, the potential of such systems for supply chain management has not been recognized, let alone exploited. To date the use of social networking applications in dairying has been limited to the involvement of some farmers in online communities via websites such as Dairy Tas (http://www.dairytas.com.au/) and Udderly Fantastic (http://www.dairyaustralia.com.au/Standard-Items/News/Dairy-News/Udderly-Fantastic-web-forum.aspx) (Stockdale & Marshall 2011).

4.4.2 TASMANIAN DAIRY SUPPLY CHAIN DIAGRAM

Based on the above information from Interview 3 and Interview 4, Figure 4-5 is drawn to visualise the dairy supply chain in Tasmania.

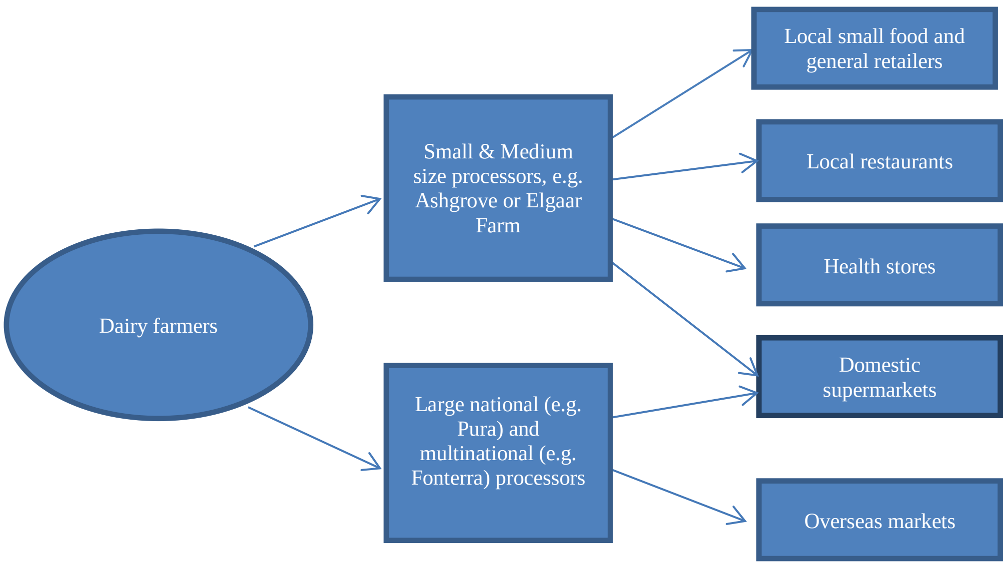

Figure 4-5: The Dairy Supply Chain in Tasmania

4.5 KEY INFORMANT INTERVIEWS IN FRUIT & VEGETABLE SUB-SECTOR

Five informants were recruited from the fruit and vegetable sub-sector. They were EXV1 with a research background, EXV2 with research and industrial background, and EXV3, EXV4 and EXV5 with industrial backgrounds, and they participated in Interview 6, Interview 7 and Interview 8 respectively. All five interviewees primarily focus on the vegetable sub-sector and only EXV2 grows fruit apart from his research activity.

Despite many attempts, a mutually convenient time and location could not be arranged with the informants focusing on the fruit industry, and therefore the interviews did not include any fruit experts. Considering the similarities across the horticulture industry, the information gained from the vegetable informants was extended to the fruit sub-sector at this stage. In the subsequent survey phase, interviewees from the fruit sub-sector were recruited to supplement and validate the tentative findings.

4.5.1 TASMANIAN VEGETABLE SUPPLY CHAIN DESCRIBED BY KEY INFORMANTS

The vegetable industry in Tasmania can be characterised as an industry facing a number of challenges including increasing international competition from producers in low-wage countries, relatively high wages, tightening regulations regarding chemical use, significant and irresistible pressures from supermarkets and large processors to reduce prices; and increasing traceability requirements (again, imposed by supermarkets).

The vegetable supply chain begins at the vegetable seed producers and seedling growers who supply primary producers. Primary producers are usually under contract to supply processors, while some processors (e.g. Houston's Farm and Webster Ltd.) are involved in both growing and processing activities. In the processing center, a series of operations such as cutting, washing, packing and labeling are performed before delivering to customers. The large supermarkets are dominant players in the vegetable supply chain in Tasmania, taking about 50% to 60% of total production. The remaining produce is sold to small grocery stores and specialist outlets.

Some of the larger vegetable growers and processors have invested in, and implemented, a considerable amount of technologies and systems in their farming and processing activities, particularly where they have adopted precision farming practices in which production inputs and activities are geared optimally to reduce in-field variability. The larger organisations like Simplot Australia and McCain Foods (Aust) Pty Ltd. have implemented totally automated factory operations.

However, there is little ICT used in the Tasmanian vegetable supply chain. The use of computer systems is fragmentary and many systems are still standalone. Some of these vegetable companies are currently using Microsoft Excel to record the data (which fulfills their basic ICT needs) while a significant vegetable processor dealing with many growers was still using fax to take orders. Most of these companies do not even have websites, let alone more sophisticated ICT use.

There were encouraging findings that, according to EXV4, Simplot Australia has made a considerable amount of investment in ICT systems such as Farm Works. This ICT package includes a handheld computer integrating GPS, digital camera, and optional cellular modem which is specifically designed for record keeping and data exchange in farming conditions. The image of a similar model of the device is illustrated in Figure 4-6. Being a field investigator, EXV4 uses the PDA to record production data. He normally synchronises the entries in the PDA with his desktop and backs up the system every time he finishes an inspection trip. The back-up is a way to avoid data loss as the system sometimes experiences technical difficulties.

Figure 4-6: PDA used by the Vegetable Field Officers

Some of the larger vegetable producers are beginning to seriously consider fully integrated ICT systems, including supply chain sub-systems to cope with the demands of the supermarkets and large processors. However, the implementation has not been easy and the problems are complex.

Losing control of production data is one of the concerns expressed about dealing with large supermarkets. To gain control over market data, large supermarket chains have pushed vegetable growers to adopt the supply chain management system used by the supermarkets. Implementing this system can improve growers' supply chain management to some degree, but at the price of losing control of business information. For example, Coles Supermarket can interrogate and control the business information. For this reason, Houston's Farm has resisted use of the system provided by the large supermarkets. Alternatively, some vegetable firms have been developing their own computer-based systems to enable them to improve their supply chain management. A major vegetable processor in Tasmania, for example, spent around A$100,000 to hire a consulting company to build them an in-house system. However the system was abandoned and the investment has become a loss as it was never functional.

This kind of ICT investment is a challenge for farmers who are short of resources and operate their family farm for survival even when there is a substantial need for ICT. The smaller vegetable farmers have (to date) only adopted rudimentary ICT. Nonetheless, even these producers are beginning to look seriously at ICT adoption, since fulfilling traceability and other supply chain requirements is becoming difficult via pen and paper systems only. Moreover paper-based records are difficult to keep, and difficult to manage when dealing with various business partners. The paper-based system also leads to the difficulty of unit price calculation determined by a range of information such as pre-farm costs, on-farm costs, and post-farm costs, which are recorded on different sheets of paper. Currently, it takes some of them two to three weeks to calculate out the unit price. As a result, these firms are unable to accurately identify defects of their operation, and are vulnerable in bargaining with supermarkets that can compare the various offers. These farms have adequate accounting systems, but they are not linked with production systems. There is a need to integrate their accounting and production systems.

There are a range of factors affecting ICT application in the vegetable supply chain. Cost, reliability, connectivity and security are considered as the main matters of concern regarding ICT adoption in the vegetable industry. A lack of competent systems and suitable devices specifically designed to suit the farming environment have been identified as inhibitors for growers to adopt ICT. Lack of recognition in the current legislative system is also a hurdle for widespread adoption of ICT systems in the conservative agribusiness domain. Paper-based documents and forms with a personal signature have been traditionally accepted as a signed legal document, while digital data is not accepted in general.

We note that, like the dairy industry participants, those in the vegetable industry, while very familiar with Web 2.0 social networking systems, have not considered such systems for supply chain management. While such systems may not be adequate for the larger vegetable producers, it is envisaged that something like a simple ‘Facebook commerce’ system might well be a very suitable solution for the smaller vegetable producers.

4.5.2 Tasmanian Fruit and Vegetable Supply Chain Diagram

Drawn from the above outcomes, Figure 4-7 represents the fruit and vegetable supply chain in Tasmania.

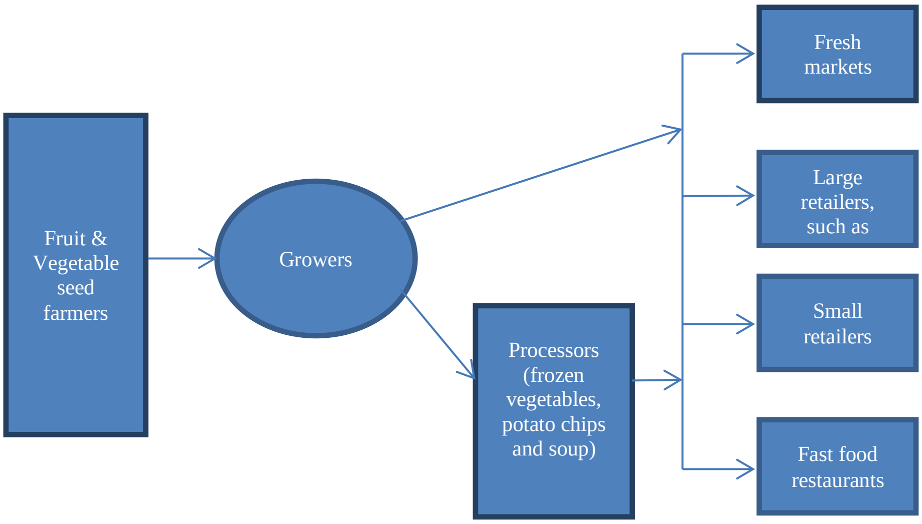

Figure 4-7: the Fruit and Vegetable Supply Chain in Tasmania

4.6 Key Informant Interviews in Livestock Sub-Sector

In the livestock sub-sector, EXL1 (with industry background) and M2 (with both industry and research backgrounds) were recruited for Interview 9 and Interview 10 respectively. During the interviews, EXL1 piloted the survey questionnaire while M2 participated in the survey.

4.6.1 Tasmanian Livestock Supply Chain Described by Key Informants

With regard to the livestock supply chain, information was collected regarding the lamb sub-sector of the livestock industry. Other sub-supply chains in the livestock industry, the industry expert assured us, were similar. In the lamb-meat supply chain the farmers focus their business on tending and growing lambs and use livestock agents for a number of supply chain management services. There are three major sales channels:

- sales direct to meat processors (when ready to slaughter);

- sales to other farmers (trade lambs not ready to slaughter);
- and sales to processors/supermarkets under contracts.

A popular selling method for livestock producers is the sale of their stock in sale yards via an auction process. The auction is run by the agents and the farmer takes home the sales income that he receives on the day. The livestock agents operate sale yards and sell lambs at slaughter weight (normally 42-50 kg/each) to supermarkets or butchers. Underweight lambs are sold to other farmers for fattening, and then re-sold via an agent when they do reach slaughter weight. There are minimum health and hygiene standards regulating these transactions.

Due to the time and effort involved and the difficulties of maintaining a constant supply of lambs to supermarkets, farmers tend not to manage the distribution and sale of their livestock. Farmers are usually not able to sell their product directly to the end customers (i.e. the consumers of the meat) as they do not have the processing facilities to process from live animals into saleable goods (i.e. chops, legs of lamb, racks etc.). There are significant costs involved in setting up such processing facilities, significant legal requirements, Occupational Health and Safety (OH&S) requirements, quality assurance and, of course, appropriate animal welfare management.

Instead, livestock agents play an important role in managing activities and transactions between farmers and processors. Agents not only help to manage sales and the financial credits and transfers of funds as required, but also manage supply chain activities in ways that ensure health and hygiene standards are met. Their work is on a commission basis.

However not all farmers use agents to sell livestock. Some may themselves organise delivery of a specific number of lambs direct to a processor. Obviously, the price received is what the processor is willing to pay at the time of delivery (as agreed just prior to delivery). In this context, a challenge is that potential customers (especially overseas customers) find it difficult to identify and approach individual farmers. It is interesting to speculate whether, with good ICT systems for supply chain management, farmers could reduce their reliance on livestock agents or improve the supply chain efficiency and thus possibly earn a greater proportion of the profits of the livestock supply chain.

Another challenge for farmers and others in the livestock supply chains is price fluctuation. Price fluctuates markedly in these supply chains due to supply and demand factors across Australia and internationally; factors which, in turn, are influenced by seasonal conditions including droughts and floods. Overseas economic conditions generally, exchange-rate fluctuations and, to some extent, marketing campaigns are also factors which cause, or at least influence, price fluctuations. Information regarding prices and the factors that influence them is important for supply chain participants who seek to maximise revenues and profits. Price fluctuations are also attributed to lack of collaboration. For example, when the lamb price rises, many more farmers start to grow lamb so that there is an over-supply and the price drops. M2 said:

> *"There is an old saying "nothing kills high prices like high prices."*

The collaboration required to deal with these types of price fluctuation is difficult to achieve as it requires massive farmer engagement, commitment and compromise. Meanwhile the government is unlikely to intervene as a free economy is the foundation of Australia's economy.

To overcome the challenge, farmers usually diversify their products and spread the risks over a number of enterprises. For example, a farmer may grow lambs, merino sheep and poppies in his agribusiness. Thus, if one enterprise fails, they hope that other enterprises will be profitable and cover the loss.

A significant number of ICT-based technologies and systems are used by livestock farmers. In the lamb and sheep-meat subsector, ICT-based solutions include electronic (RFID) sheep tags, electronic sheep weighing scales, automatic sheep drafters, tractor GPS units; and wireless and other technologies associated with the control and operation of irrigation infrastructure. In addition to these technologies, the farmers use a number of modes of ICT-based communication including e-mail and social networking sites. Most of the technology investments support in-farm production operations. There is little use, by farmers at least, of ICT-based supply chain management systems. This is evidenced by the use of blackboards for record keeping in cattle sheds and a general inability to trace the livestock after selling them at the farm gates.

Farmers want to see immediate benefit from any IT investments; however, poor telecommunication infrastructure, high Internet access fees, lack of mobility, difficulty of use, lack of perceived need and compulsory adoption were identified as the inhibitors to wider adoption of ICT. Lack of mobility in particular is a weakness of existing ICT systems that inhibits wide adoption. Some farmers generally use some ICT in managing their farms; however, these systems are located in offices and are not available on the farming site where farmers actually record and input the data. In practice, farmers may use a blackboard on site to record the information and transfer the data into paper or input into a computer after work. The transfer is a difficult job and an administrative burden for exhausted farmers. Poor telecommunication infrastructure and high costs are also considered as barriers for ICT adoption. EXL1 complained that the Internet access at his farmhouse relies on a satellite signal which is poor and unstable. ICT use, especially web development, is considered as a difficult task and unnecessary work for farmers. In particular, EXL1 believed that his small farm operation did not require sophisticated and complicated ICT systems. Mandatory requirements for the use of ICT in any way was also considered as an inhibitor of ICT acceptance, while voluntary use was believed to enhance the degree of acceptance.

There is a question whether significant opportunities are being missed. Particularly given that, with appropriate ICT support, farmers may be able to take over some of the activities of the livestock agents and thus garner a larger share of supply chain revenues or improve efficiency. In this context there is the possibility, as with the other sectors examined, of using Web 2.0-based systems as a basis for supply chain management if reliable and affordable Internet access is available.

4.6.2 TASMANIAN LIVESTOCK SUPPLY CHAIN DIAGRAM

Based on the above information gained from the interview 9 and interview 10, Figure 4-8 is drawn to visualise the livestock supply chain, especially the cattle in Tasmania. The lamb supply chain may be a little different as the time scale for lamb production is much shorter.

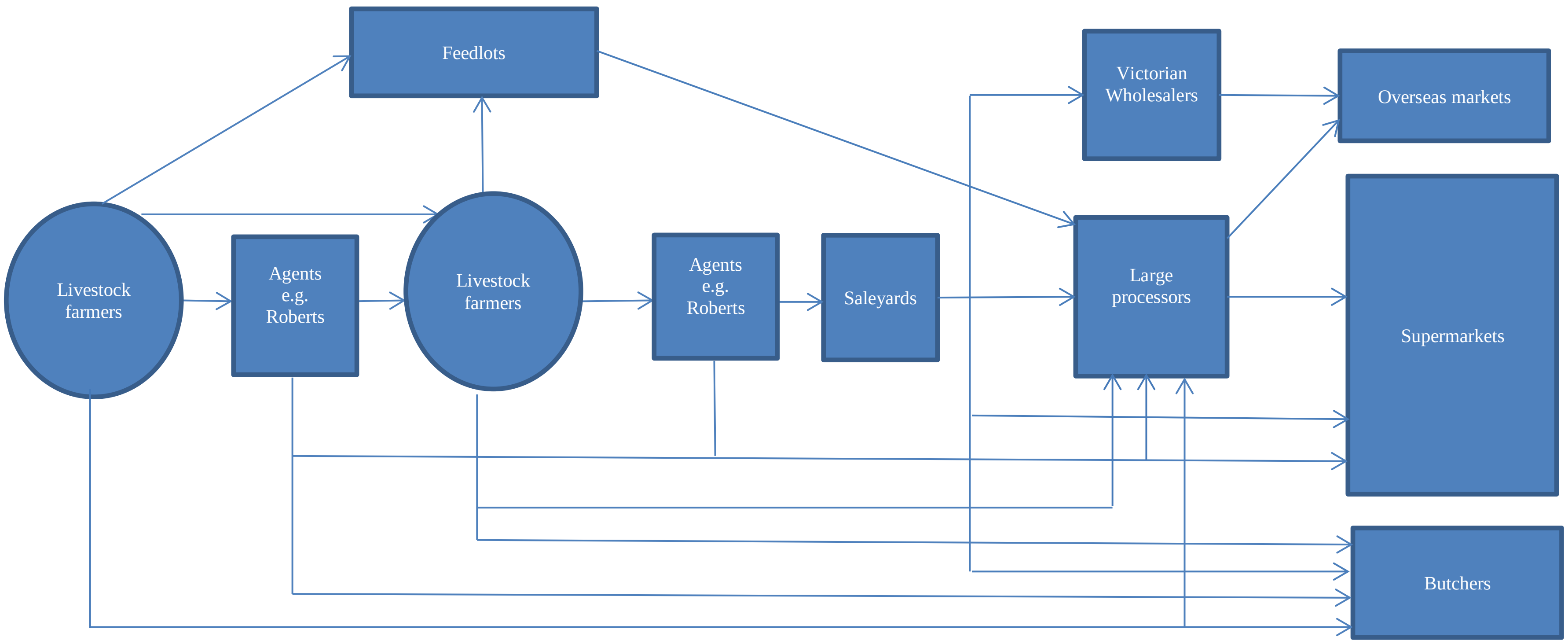

Figure 4-8: The Livestock Supply Chain in Tasmania

4.7 CONCLUSION

The Key Informant Interviews, as designed, provided overviews of the seafood, dairy, fruit and vegetable and livestock sub-sectors and, more importantly, the ICT use in these supply chains.

Despite diversity, within the sub-sectors the primary producers generally have advanced production (on-farm) technologies such as automatic milking equipment and efficient irrigation systems but are lacking the SCM concept and competent ICT to support their SCM. Most primary producers are focusing mainly on production and do not have the interest, competence or opportunities to manage their supply chains. This was evidenced by the fact that generally the farmer's involvement stops at the farm gate once buyers collect their produce and the subsequent traceability-related information is not shared with the primary producers. As a result, it is not necessary for primary producers to even think about their SCM, and therefore there is little ICT developed for them to cope with their SCM. Due to their limited resources, most primary producers are unable to develop their own ICT-enabled SCM software, and thus they have been communicating with other supply chain partners by using traditional means such as face-to-face and phones as they have been for decades, and they often seem to consider that using email is major achievement.

There are some encouraging findings that some processors, which include the primary producers who have extended their operations to processing activities, have applied ICT to improve their supply chain management, but the use is rudimentary and fragmentary at the primary producers' end.

Since there is little ICT-enabled SCM being used by agri-food SMEs, as a particular stream of ICT, specific uses of Web 2.0 technologies are lacking in the agri-food supply chains. However, a few primary producers have used the Web 2.0 technologies for personal purposes.

The information gained from the Key Informant Interviews forms the basis for the major empirical data collection in the subsequent survey stage. In the next chapter, Chapter 5 Survey Data Collection, detailed information about the survey design is presented.

Chapter 5

Survey Data Collection

5.1 INTRODUCTION

The outcome of the first stage of the data collection employing a series of key informant interviews was presented in the previous chapter. This chapter describes the second stage of the empirical data collection which aimed to test the Rural Web 2.0 Technology Acceptance Model (RuWebTAM).

The second-stage data collection was further divided into two phases – main survey and follow-up survey. While the main survey was planned in the original research design, the follow-up interviews were added subsequently to gather supplementary information deemed necessary after the initial analysis of the main survey data.

The survey aimed to address the following subsidiary research questions which are answered in Chapter 9 Conclusion.

SRQ3: How are individual SMEs using ICT for their supply chain management?

SRQ4: What is the current state of agri-food SME's use of Web 2.0 in managing their agri-food supply chain?

SRQ5: What differences exist between each agri-food sub-sector in applying Web 2.0 technology to their supply chain?

The stage of the research project presented in this chapter, Chapter 6 Survey Analysis and Chapter 7 Survey Analysis – Research Model Modification is highlighted in Figure 5-1.

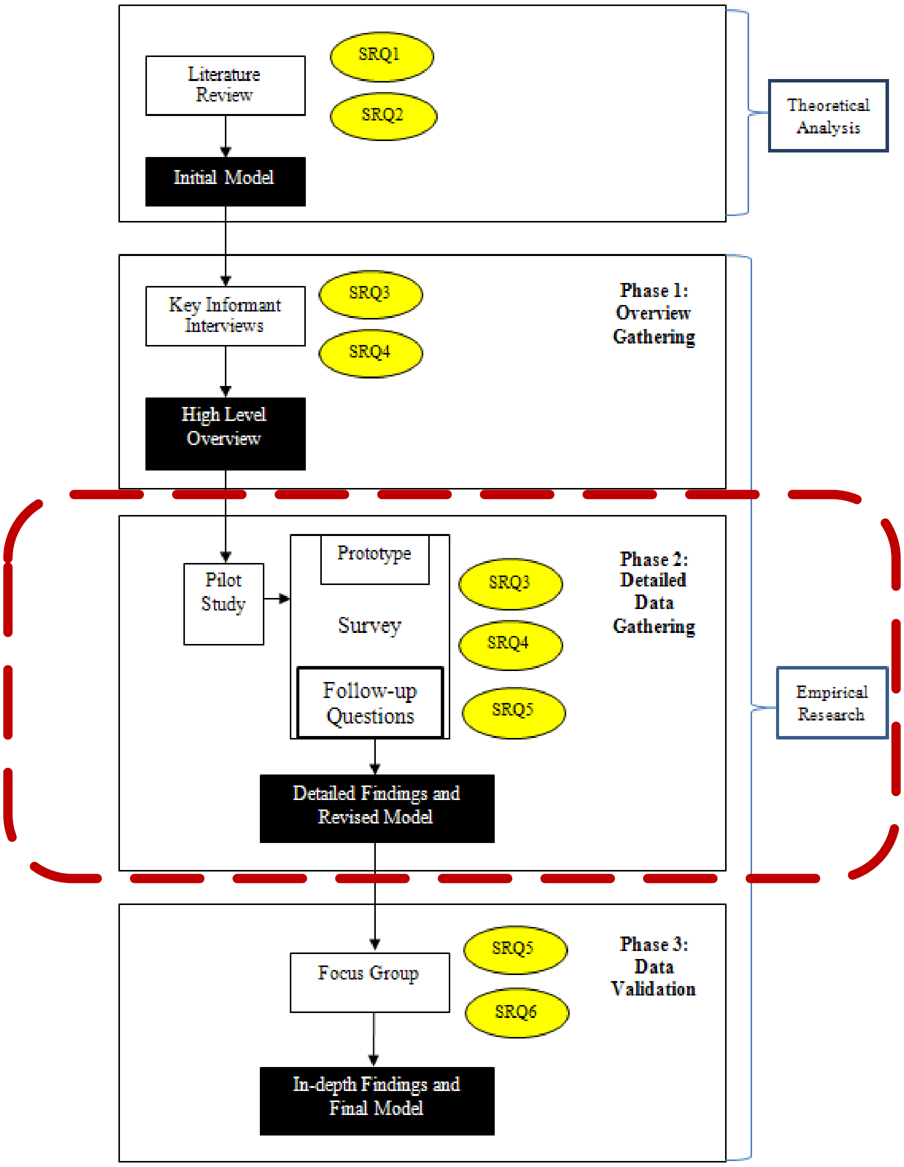

Figure 5-1: The Stage Described in Chapter 5

The remainder of this chapter is organised as follows. Section 5.2 describes the survey administration. Section 5.3 discusses the design of the survey questionnaire followed by Section 5.4: the Web 2.0 SCM prototype demonstrated in the survey interviews. Section 5.5 presents the design of follow-up questions and the administration of the follow-up survey. Section 5.6 concludes this chapter.

5.2 SURVEY ADMINISTRATION

This section describes the background, design and administration of the survey, in particular: the composition and development of the questionnaire, the sample frame, the recruitment of interviewees, the period of survey data collection and the survey administration.

5.2.1 SURVEY OVERVIEW

A number of cross-sectional surveys were conducted to elicit information on the use of ICT and, more importantly, the use of Web 2.0 by SMEs in the agri-food supply chain during the period October 2011 through to March 2012.

The invitation emails containing the information sheet and the consent form for the survey interview were sent to a large number of potential interviewees. Once the consents were obtained there was a discussion with each of the participants regarding suitable times and a place for the meetings. These survey interviews were held in a range of places including the interviewees' farms, farm houses, fishing boats, processing factories and the investigator's office.

The surveys were carried out through face-to-face semi-structured interviews. Face-to-face interviews were undertaken because, given the time management difficulties faced by many farmers, there was the likelihood that their busy lives might well result in incomplete online survey questionnaires. Moreover, face-to-face semi-structured interviews can both minimise deviation caused by ambiguous questions and obtain rich information comprising both quantitative and qualitative data. The semi-structured interviews, based on a questionnaire, permitted the investigator to obtain both quantitative and qualitative information from respondents. (The questionnaire was piloted before the survey). Moreover, the initial questionnaire consisting of 16 questions was refined and, in particular, two additional questions that had been identified as important were incorporated into the questionnaire after several survey interviews.

Given that many interviewees were expected to have a limited understanding of Web 2.0, a demonstration of a Web 2.0 supply chain management prototype was presented during the survey. It took 25 minutes to complete the prototype demonstration before moving on to discuss the Web 2.0-related questions (i.e. Q.16, Q.17 and Q.18). During the demonstration, the Web 2.0 principles indicated by each step were addressed. A range of devices including laptop, iPad and smartphone were used to emphasize the flexibility and accessibility of the Web 2.0 prototype. The interviewees were also encouraged to trial the prototype using their own computers and mobile devices such as tablets and smartphones. The demonstration permitted the interviewees to observe how this Web 2.0 solution could enhance their supply chain management without risking their real businesses.

The interview was divided into three parts: completion of questions 1-15, the prototype demonstration, and completion of questions 16-18 which specifically focussed on Web 2.0 issues. Depending on the interviewees' availability, the survey interviews varied from 20 minutes to more than 60 minutes duration. Due to their busy schedules, a few participants could only spend 20 minutes on the interviews, which made it impossible to complete all the designed procedures and the Web 2.0 prototype demonstration. In order to give these participants a basic idea about Web 2.0, the printed PowerPoint slides for the demonstration were presented and explained to them. These printed slides provided a fundamental outline of Web 2.0 principles to enable them to answer the questionnaire. Overall, this resulted in 28 usable surveys from across Tasmania.

5.2.2 SURVEY POPULATION AND SAMPLE SIZE

The majority of the interviewees in this project were primary producers and, in particular, farmers and fishermen. In order to obtain a better understanding of the interactions in the agri-food supply chain, a small number of processors and distributors were also invited to complete the survey. For clarity, the distributors are defined as those companies who purchase primary products from a number of primary producers and resell them to other parties, while processors provide a value added service to the primary products before on-selling the products. In some cases, there may be overlap between distributors and processors, which means that the distributors may process the primary products before selling them. Apart from three primary producers with processing activities, one distributor in the seafood sub-sector and one processor in the dairy sub-sector were recruited. This distributor in the seafood industry had been a fisherman before working as a distributor.

To obtain a broad representation of data, interviewees were selected from four important sub-sectors in Tasmania. These were seafood, dairy, fruit & vegetable and meat. In particular, there were nine from seafood, seven from dairy, two from fruit, six involved in both vegetable & livestock and four from the livestock sub-sector.

The interviewees for the survey were recruited by three approaches.

- Contacts referred by the informants who participated in the Key Informant Interviews;
- Contacts referred by local farmers or fishermen associations such as the Tasmanian Farmers and Graziers Association (TFGA), the Tasmanian Dairy Industry Authority (TDIA), the Tasmanian Seafood Industry Council (TSIC) and the Tasmanian Rock Lobster Fishermen's Association (TRLFA);
- Contacts established at relevant exhibitions such as the Royal Hobart Show and Taste of the Huon.

The survey was conducted across Tasmania. The regions visited included Hobart, Kingston, Sorell, Margate, Cygnet, Gretna, Ouse, Birchs Bay, Campbell Town, Broadmarsh, Longford, Launceston, Westbury, Deloraine, Burnie, Ulverstone, Smithton, Latrobe, Devonport, Sisters Creek and Bicheno. These regions included the early NBN roll-out areas such as Smithton and Midway point, which thus permitted the assessment of the initial impact of NBN on businesses in those areas. Figure 5-2 illustrates the location of the interviewees and the available NBN rollout at the time the interviews were conducted. A small sample was chosen because of the expected difficulty in obtaining farmers' or fishermen's consent for face-to-face interviews. Constrained by time limits and resources, only 28 usable interviews were conducted. This accounts for a small percentage of the total number of businesses in the agri-food sector. All interviewees were primary decision makers in their businesses. The fact that the sample accounts for such a small percentage of the total population means that the survey results are not generalisable to the entire Tasmanian agri-food industry. However, the findings are meaningful when supplemented by the fully analysed qualitative data based on the transcription of the interviews.

Figure 5-2: Location of the interviewees

The blue pins indicate the interviewees' locations. The pink pins are the areas with NBN roll-out at the time of the survey. The information is based on the NBN rollout map in Tasmania as at 25th March 2012 (http://www.nbnco.com.au/rollout/rollout-map.html).

5.3 DESIGN OF THE SURVEY QUESTIONNAIRE

The survey questionnaire was designed on the basis of a comprehensive literature review which also constituted the foundation of the research model. The initial questionnaire of 16 questions was piloted and refined based on the outcomes of the initial interviews. After 17 survey interviews had been completed, it became apparent to the investigator that two additional questions often asked during the interviews needed to be incorporated into the questionnaire and used for the subsequent interviews. These two questions are “Questions 4: Does your business have a website or any online web presence?” and “Question 18: If you know of any agri-food supply chain projects you believe might be useful for this research, whether Web 2.0-related or not, could you please include a brief summary below – I would be especially grateful for a URL link to any relevant webpages or reports.”. Question 4 sought information regarding the use of any online web presence, which is considered as a measure of a higher level of Internet use as general Internet use was prevalent among the interviewees. Question 18 was designed to obtain information about similar and relevant ICT projects in this field. For the sake of clarity, the questionnaire in the subsequent paragraphs refers to the latest version of the questionnaire with 18 Questions. The latest version of the questionnaire is presented in the Appendix A.

Given that the primary producers had limited time for the interviews, the questionnaire was limited to 18 questions, and widely employed close-end questions. The 18 questions were of five different types. Table 5-1 lists the question types in the questionnaire.

Table 5-1: Question Types of the Questionnaire

Question types	**Question number**
Single choice	Q.1, Q.2, Q.3, Q.4, Q.5, Q.6
Multiple choices	Q.7, Q.8, Q.12, Q.15
Likert scale	Q.10, Q.13, Q.14, Q.16
Fill in the blank answers	Q.9
Open end questions	Q.11, Q.17, Q.18
Remark: to allow possible answers beyond the available options, Q.1, Q7, Q8, Q12, Q13, Q14, Q15 and Q16 also provided an “Others (please specify)” row	

These questions can be categorised into the following sections: Company profiles and basic Internet use, agri-food supply chain management, ICT use in their SCM and Acceptance of Web 2.0 SCM. Since it was expected that the majority of interviewees might not have adequate knowledge (or even no knowledge) about Web 2.0, a presentation demonstrating a Web 2.0 SCM prototype was carried out before the interviewees were asked to answer the last three questions (i.e. Q16, Q17 and Q18, on Acceptance of Web 2.0 SCM). Details of the Web 2.0 SCM prototype are discussed in Section 5.4.

To increase the reliability of response measures, some important information was asked twice in different questions. For example, Q.9 and Q.12 sought an answer to degree of email use, and Q.9, Q.12 and Q.15 sought answers regarding use of Shared Electronic Documents.

The rest of this section uses the supporting literature to justify each question. It is presented by sections.

5.3.1 COMPANY PROFILES AND BASIC INTERNET USE

This section initially consisted of five questions and then an additional question concerning possession of an online presence was incorporated. Q.4 was an additional question incorporated into the questionnaire after 17 interviews had been completed.

Question 1 gauged information about the sub-sectors to which the participants' businesses belong. The motivation for this was because many researchers believe sector is a significant determinant of ICT use (Matopoulos, Vlachopoulou & Manthou 2007). Moreover the multiple choice questions allowed for the discovery of any farm diversification which is believed to be an influencing factor for ICT usage (Park & Mishra 2003).

Question 2 concerned general Internet use, which included a range of ICT-related activities such as email, online search, online order, internet banking and website use (Burke 2010) which were also specified in question 4. In practice, our interviewees were mostly small and medium size agribusinesses (effectively family-size businesses), so there was no clear boundary between business use and personal use of ICT. For example, they may look up weather reports to determine future farming or fishing schedules and also for their private activities; hence, any Internet use done by those running the business was considered to be a case of business Internet use.

Question 3 sought answers about NBN use. In the context of the NBN roll-out, the comparison of interviewees using or not using the NBN was also a matter of interest. The results were intended to elicit a better understanding of the impact of the NBN on primary producers, most of whom reside in rural regions. This permitted comparisons and provided findings to supplement existing research about the NBN (Hill et al. 2011).

Ownership of an online presence indicated a further step in online engagement (Molla & Peszynski 2011; Simmons et al. 2007). Question 4, concerning the use of an online presence was therefore incorporated into the questionnaire partway through the survey, and was asked verbally.

Many researchers (Venkatesh et al. 2003) have indicated that age is a significant factor influencing determinants of ICT use, so Question 5 was set up to obtain the information and as a way to test the model.

Considering the influence of working experience on technology acceptance (Devaraj et al. 2008), Question 6 gauged the interviewees' years of working experience. This referred to the Domain Experience moderator of the research model.

5.3.2 AGRI-FOOD SUPPLY CHAIN MANAGEMENT

The questions in this section were designed to obtain information about the current status of the primary producers' agri-food supply chain management.

To understand their acceptance of the idea of applying ICT to their supply chain management, it was essential to gain an overview of their supply chains, as agri-food supply chains can be very complicated and diversified (Richards 2006). Moreover, the customer type is believed to be an important determinant for ICT adoption (Burke 2010). Q.7 and Q.8 sought information about any upstream and downstream supply chain partners.

Q.9 asked interviewees to number their communication methods in the order of frequency of use. There was a need to understand the interviewees' overall communication methods before moving to investigate their ICT use (Manthou et al. 2005) in order to gain a comprehensive view. For the purpose of comparison, the question was further divided into four categories: customers, suppliers, brokers and transport companies.

Q.10 aimed to determine how satisfied the interviewees were with their current communication methods and, more importantly, the reasons for their opinions (which were gathered in Q.11). Their opinions regarding the current communication technology helped identify the weaknesses and strengths of existing communication methods, which in turn elucidated the motives and obstacles in applying ICT and in particular Web 2.0 to communications with their supply chain partners (Akkirman & Harris 2005; Bughin et al. 2009; Ooi et al. 2011).

5.3.3 ICT ADOPTION IN SCM

This section was designed to uncover the current state of ICT use in the interviewees' SCM and their opinions about applying ICT to their SCM.

Q.12 investigated ICT-enabled communication methods beyond conventional face-to-face, phone, and postal mail. This was designed to increase understanding of the current state of ICT use in agri-food SCM and permits comparisons with previous studies (Matopoulos et al. 2009). Table 5-2 compares the ICT types discussed by Matopoulos et al. (2009) and the equivalent ICT used particularly for SCM that are listed in this question. Apart from email, the ICTs employed for SCM are considered as e-marketplace, e-SCM, e-CRM and Collaborative Platforms in previous research, which are more complicated e-Business applications (Matopoulos et al. 2009).

Table 5-2: Comparison of ICT types

IT types discussed in previous work (Matopoulos et al. 2009)	**ICT used for SCM that are discussed in Q.12**
E-mail	E-mail
Website	N/A
Intranet	N/A
Selling-buying online	N/A
Extranet	N/A
E-banking	N/A
E-marketplace	Web-based supply chain management platform (e.g. eBay)
E-SCM, E-CRM	Particular software provided by the suppliers or the customers; Electronic Data Interchange (EDI); Web EDI
Collaborative Platforms	Shared Electronic Documents

Q.13 and Q.14 gauged the interviewees' opinions regarding the motives and obstacles for adopting ICT in their SCM. The motives and obstacles listed in the questionnaire are supported by a number of references. Table 5-3 shows these influencing factors and their supporting literatures.

Table 5-3: Factors Influence Applying ICT to SCM and Supporting Studies

Number	Influencing Factors	Supporting Studies
1	Required by large customers	Matopoulos et al. (2009)
2	Better traceability	Galliano and Orozco (2011) and Myae and Goddard (2012)
3	Better book/record keeping	Lu and Swatman (2009) and Tham-Agyekum et al. (2010)
4	Faster transactions	Manthou et al. (2005); Molla and Peszynski (2009) and Volpentesta and Ammirato (2010)
5	Better access to market data (e.g. market trend, consumer preferences, etc.)	Rolfe et al. (2003)
6	Better access to experts outside the enterprise (e.g. Government Departments, agronomists, etc.)	Glendenning and Ficarelli (2011) and Marantidou et al. (2011)
7	Better unit price calculation	Hassan et al. (2013)
8	Better customer service	Manthou et al. (2005) and Lu and Swatman (2009)
9	Better transportation of produce	Manthou et al. (2005)
10	Not accessible in field, i.e. available ICT devices lack mobility	Wu and Hisa (2008)
11	Poor telecommunications infrastructure	Warren (2004); Lu and Swatman (2009) and Brush and McIntosh (2010)
12	High cost of telecommunications provider (e.g. Telstra)	Tan et al. (2010)
13	Not willing to change existing way of doing business	Matopoulos et al. (2009)
14	Lack of IT technical support	Brush and McIntosh (2010)
15	Lack of manager's support	Gregor et al. (2002)

16	Lack of staff with suitable training	Adegbidi et al. (2012) and Tan et al. (2010)
17	Difficult to use	Manthou et al.(2005) and Brush and McIntosh (2010)
18	Negative comment from our community	Warren (2004)
19	Security reasons	Gregor et al. (2002); Manthou et al. (2005); Warr (2008) and Tan et al. (2010)
20	Reliability of the SCM software	Warr (2008)
21	Flexibility of the SCM software	Kumar et al. (2007) and He et al. (2007)

Given that few interviewees had good understanding about possible Web 2.0 use for their SCM prior to the study, and Web 2.0 use is under the umbrella of ICT use, the findings of these sections and, in particular, the motives and inhibitors about adopting ICT in SCM were extended to motives and inhibitors for adopting Web 2.0 enabled SCM.

5.3.4 ACCEPTANCE OF WEB 2.0 SCM

In this section four questions were designed to investigate the current state of Web 2.0 use and, more importantly, Web 2.0 use in SCM.

Q.15 listed a number of popular and typical Web 2.0 applications and investigated their use. Although social networking technologies (being an important part of Web 2.0 technologies) are believed to be significant for agribusiness owners, the use of these emerging social networking ICTs among primary producers are still limited, and there are few studies on this issue (Burke 2010). The survey questions were designed to increase understanding of their use of social technologies which is an important component of web 2.0.

The objective of Q.16 was to identify the determinants for the interviewees to apply Web 2.0 to SCM. There is a range of advantages in adopting Web 2.0-enabled SCM such as ease-of-use, ease of contributing contents, low IT investment, collaborative and interactive environment, mashups and easy integration of different applications and systems, and crowd sourcing (Ooi et al. 2011) but primary producers' opinions on the importance of these advantages was unknown. Thus this question was designed to gather opinions about the application of Web 2.0 to their SCM.

Q.17 was an open-end question to identify external factors that influenced the adoption of Web 2.0-enabled SCM as many researchers suggest that social and other external factors have significant impacts on ICT adoption (Driedonks et al. 2005; Marantidou et al. 2011; Venkatesh et al. 2003). Within the context of the NBN roll-out in Australia, the investigator also has an interest in assessing the actual impacts of NBN on their intention to apply ICT, and in particular Web 2.0, to their SCM.

The objective of Q.18 was to supplement the investigators' knowledge about Web 2.0-enabled SCM in the agri-food industry. The interviewees had expertise and many years of experience in their specific sectors. This open-ended question was designed to identify any Web 2.0-related research in the agri-food industry about which the investigator had not been aware.

The questions and their supporting studies are summarised in Table 5-4.

Table 5-4: Questionnaire Questions and the Supporting Studies

Question numbers	**Questions**	**Supporting Studies**
Q.1	Which agricultural sector is your company in?	Matopoulos et al. (2007)
Q.2	Does your company use the Internet?	Burke (2010)
Q.3	Does your company use the National Broadband Network?	Hill et al.(2011)
Q.4	Does your business have a website or any online presence?	Simmons et al.(2007) and Molla and Peszynski (2011)
Q.5	Which age group do you belong to?	Venkatesh et al. (2003)
Q.6	How many years have you been working in this sector?	Devaraj et al. (2008)
Q.7	Are you able to identify your customer groups?	Richards (2006) and Burke (2010)
Q.8	Could you please identify your supplier groups?	Richards (2006)
Q.9	How do you communicate with your trading	Manthou et al. (2005)

	partners?	
Q.10	How satisfied are you with the way/s you currently communicate with your customers and suppliers?	Akkirman and Harris (2005); Bughin et al. (2009) and Ooi et al. (2011)
Q.11	Please explain the reasons for your answer to Q.10	Akkirman and Harris (2005); Bughin et al. (2009) and Ooi et al. (2011)
Q.12	Which of the following Information Communication Technologies (ICT) have you used to do business with your Supply Chain trading partners?	Matopoulos (2009)
Q.13	How important were the following motives for adopting ICT in your Supply Chain Management?	See Table 5.2
Q.14	How important are the following obstacles in preventing you from using Information Communication Technology in your Supply Chain Management (SCM)?	See Table 5.2
Q.15	Which of the following Web 2.0 applications have you used?	Burke (2010)
Q.16	If you are using Web 2.0 for your Supply Chain Management, which of the following factors influenced you?	O'Reilly (2007) and Ooi et al. (2011)
Q.17	Are there any **external** factors leading you to use Web 2.0 in your supply chain management, e.g. your suppliers or/and customers require it; your family members or friends recommend it; or the roll-out of the National Broadband Network?	Venkatesh et al. (2003) and Marantidou et al. (2011)
Q.18	If you know of any agri-food supply chain projects you believe might be useful for this research, whether Web 2.0-related or not, could you please include a brief summary below – I	N/A

	would be especially grateful for a URL link to any relevant web pages or reports.	

5.4 WEB 2.0 SCM PROTOTYPE

Given that there was a limited application of Web 2.0 in agri-food supply chains and, prior to the study, it was predicted that many of the interviewees might not understand the abstract Web 2.0 term, the Web 2.0 SCM prototype was designed to play an introductive role in the survey interviews.

This prototype was based on Facebook and Google applications as they are typical platforms including many Web 2.0 principles, such as Web as platform, ease of use, social collaboration, two-way communications, multiple platform adaptability, and mashups. They are also popular platforms that the interviewees may be familiar with. The familiarity of these platforms was expected to help the interviewees to overcome the concerns of difficulty, security and reliability in the use of the prototype.

In order to present the distinguishing advantages and immediate benefits that Web 2.0-enabled SCM could bring to the interviewees in a limited timeframe; the prototype only consisted of a few functions and was kept simple and short. The main functions of this prototype were online order taking, electronic record keeping and traceability. These functions were selected because of their usefulness and popularity (Burke 2010; Galliano & Orozco 2011; Lu & Swatman 2009; Teng et al. 2012).

There are three main modules in this web-based prototype. These include a homepage based on a Facebook Page, an online order system based on Google Doc and a traceability system based on Google Doc and Google Map. All the data displayed in the prototype are fictive and just for demonstration purposes.

5.4.1 HOMEPAGE BASED ON A FACEBOOK PAGE

The homepage of the application is a Facebook page as illustrated in Figure 5-3. The familiar Facebook background and settings offered a user-friendly interface to the interviewees.

The Facebook-based prototype immediately illustrated a number of the advantages of Web 2.0 to the interviewees. These advantages include Web as a platform, social networking, mutual communication, ease-of-use, multiple platform adaption and mashups (O'Reilly 2007).

- Web as a platform

  The prototype can be used with any browser and anywhere with Internet access. Users are not required to install any software to use it. Figure 5-3 shows the prototype displayed on a desktop. The prototype can be accessed by the following URL:

  http://www.facebook.com/pages/Tasmanian-agri-food-supply-chain-management-site/154994284526937 or searching "Tasmanian agri-food supply chain management site" in Google search engine.

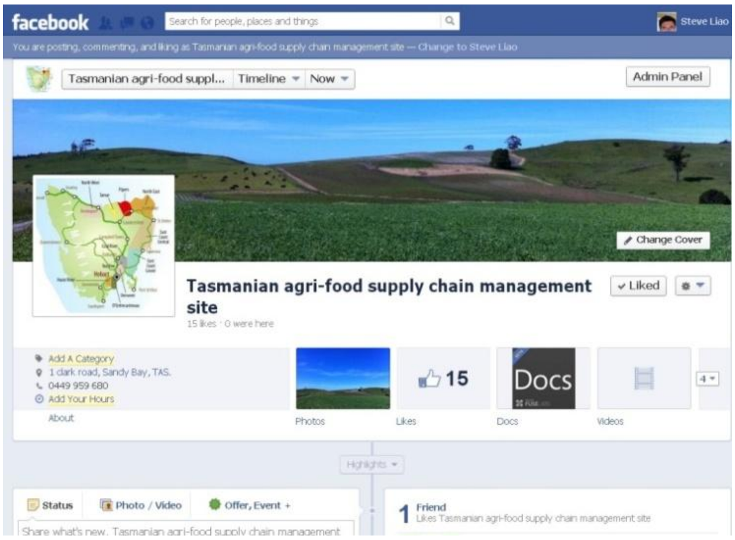

Figure 5-3: Web 2.0 SCM Prototype Displayed in Desktop

- Social Networking

  The prototype, embracing social networking principles, was designed to illustrate how agribusinesses could be exposed to broad social networks. The suppliers', customers', friends' and peers' communities and networks, and a much larger number of potential customers might potentially be attracted without advertisements. Not only their immediate contacts, but also friends and peers of their immediate contacts can reach the system. This is impossible on a conventional online order system. Figure 5-4 demonstrates the social networking effect.

Figure 5-4: Social Networking Effect

(Source: http://blog.softheme.com/)

- Mutual Communication

  The prototype envisages a mutual communication environment for owners and their friends; something that cannot easily be achieved in conventional websites. As a result, the function encouraging customer involvement permits the primary producers to access rich market data such as consumer preferences and product trends. This information is useful for the primary producers to make some more appropriate decisions to enhance their business performance.

- Ease-of-use

  The global popularity of Facebook clearly shows that it is an easy-to-use application. The prototype based on a Facebook page overcomes the difficulty-of-use of many other applications or websites. By using this prototype, users can establish an online presence for their businesses in very little time, with little effort, and at no cost. Information can be readily updated and the settings can be easily adjusted so that customers may view it online in real time.

- Multiple Platforms Adaptation

  The prototype was designed to be demonstrated on a range of devices such as desktops, laptops, tablets and smartphones. This refers to another Web 2.0 principle – multiple platform adaptations. The prototype displayed in both iPad and iPhone environments are shown in Figure 5-5.

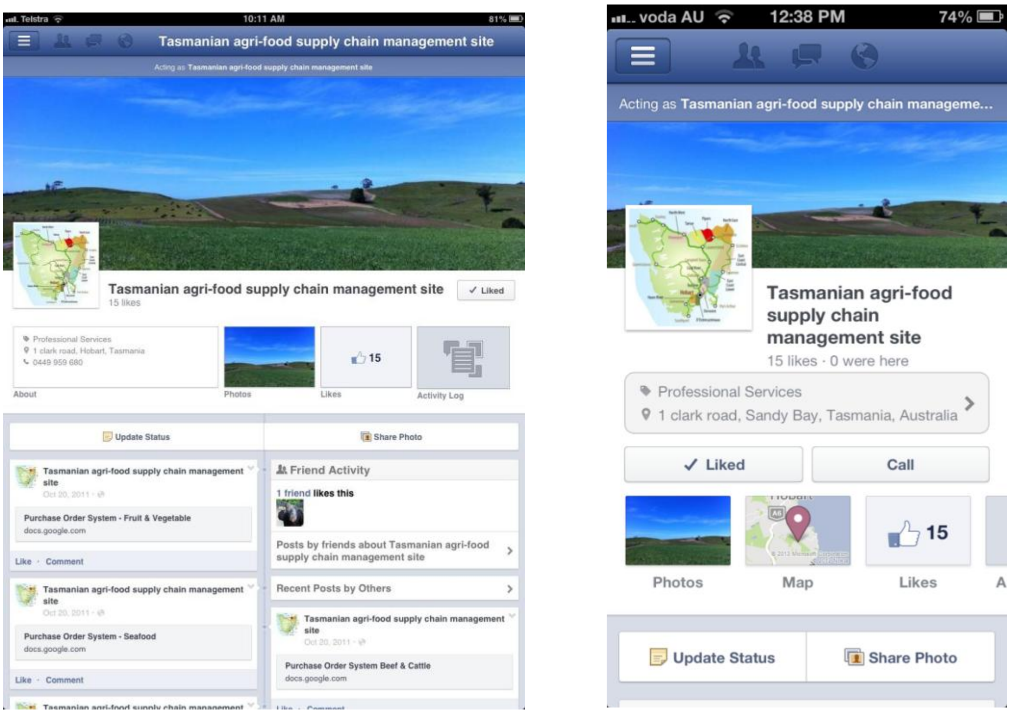

Figure 5-5: Web 2.0 SCM Prototype Displayed in iPad and iPhone

The homepage provides access to all online purchase systems, their databases and a traceability system. Figure 5-6 illustrates four online order systems and corresponding databases for seafood, beef and cattle (livestock), dairy and fruit and vegetable respectively on the homepage. The traceability system is also accessed from the home page.

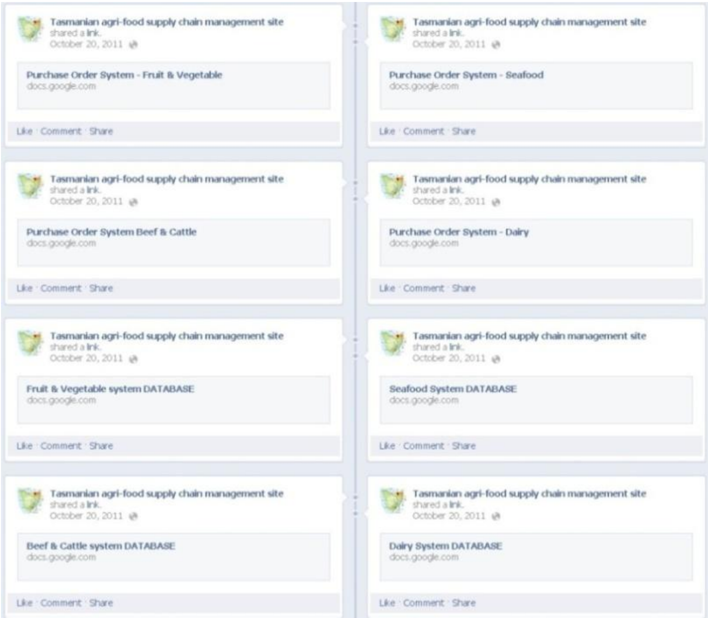

Figure 5-6: Access for each Module on the Homepage

5.4.2 ONLINE PURCHASE SYSTEM

The online order system was based on Google Drive. Given the diversity of agribusiness, the online order system displayed is a generic system and was not specifically designed for a particular business as a specific system would not be able to be used in other sub-sectors. Nonetheless, for the sake of familiarity, the items in the system have been tailored to suit each sub-sector under consideration.

The system consists of two main parts – front-end interface and back-end data base. As a part of the prototype, the online order system is consistent with the homepage and can be used by a range of devices such as desktops, laptops, tablets and smartphones. Figure 5-7 shows the seafood online order system front-end interface displayed on iPad.

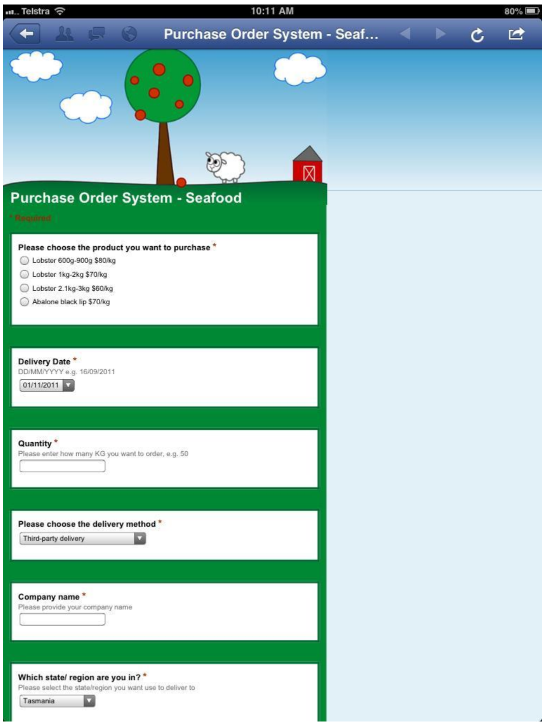

Figure 5-7: Seafood Online Order System Front-end Interface

The advantages of this online order system are summarised as follows:

- the primary producers are able to customise the system without constant professional IT assistance;
- the primary producers can modify the prices in the system to reflect changes in the market as often as they require, without the need to contact customers directly, as it will display from the systems;
- customers are able to check prices and submit orders anywhere with Internet access, 24 hours a day 7 days a week;
- the primary producers can take orders out of business hours.

In the back-end database all the submitted orders are stored in electronic format and listed in Microsoft Excel format. This makes it much easier for the primary producers to view and sort the data. The advantage of electronic data overcomes the storage and sorting difficulties of paper-based records. Where there is no Internet access, all the data can be exported as PDF and Html and used offline. Figure 5-8 illustrates the seafood back-end database displayed on iPad.

With respect to security concerns, this system permits the primary producers to easily set privacy and authorization standards. (The security could also be strengthened by email notification linked to mobile phone.) After an order submission or any changes made to the database, an email notification is sent to the mobile phone as a reminder.

Figure 5-8: Seafood Back-end Database Displayed on iPad

This system provides a summary and analysis report of aggregated data. This is to assist the primary producers to better understand their business operation and the market. Figure 5-9 shows the summary report of the seafood online purchase system. This graphic information with a range of diagrams visualises the current state of the business, and therefore assists them to improve their business management.

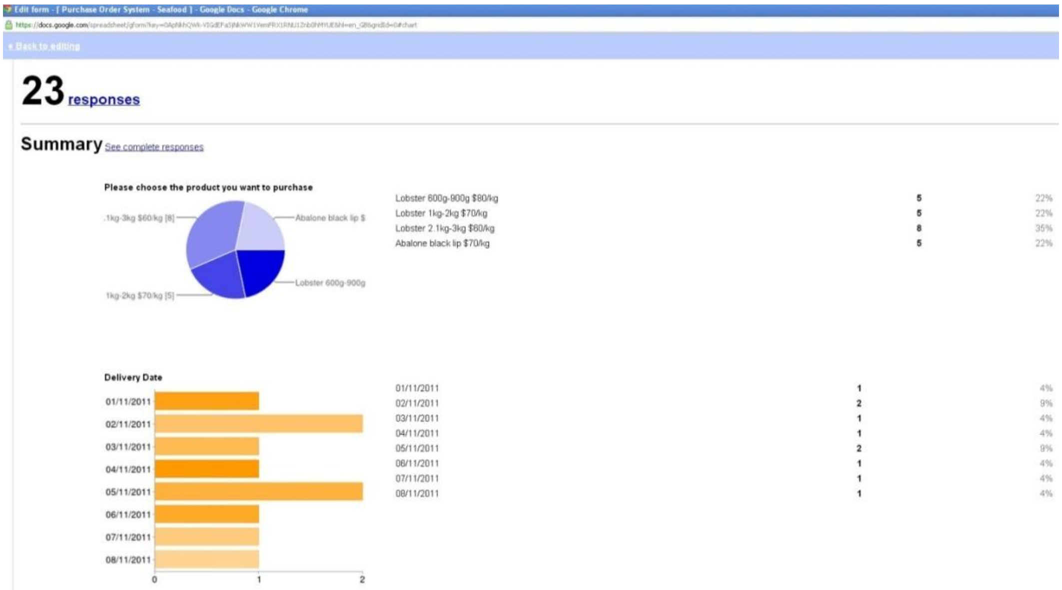

Figure 5-9: Summary Report of Seafood Online Purchase System

5.4.3 TRACEABILITY SYSTEM

In the agri-food industry, traceability ICT systems refer to the use of electronic data (e.g., order date/time or a serialized sequence number) which can be traced through the entire production flow, linking all sections of the business. These may include primary producers, processors and retailers through the supply chain (Galliano & Orozco 2011; Karippacheril et al. 2011). Using the traceability ICT system, users can easily identify the particular transaction and/or product in the supply chain.

Traceability systems have been used and demanded by large firms for a long time but have not been widely adopted by small farmers due to their limited resources (Galliano & Orozco 2011). This prototype was designed to fill the gap. The system is particularly suitable for people needing to move around while at work. It includes a front-end portal and a back-end database. Supply chain members can input the data via the front-end portal and view the data at the back-end database. The traceability system front-end interface is illustrated in Figure 5-10.

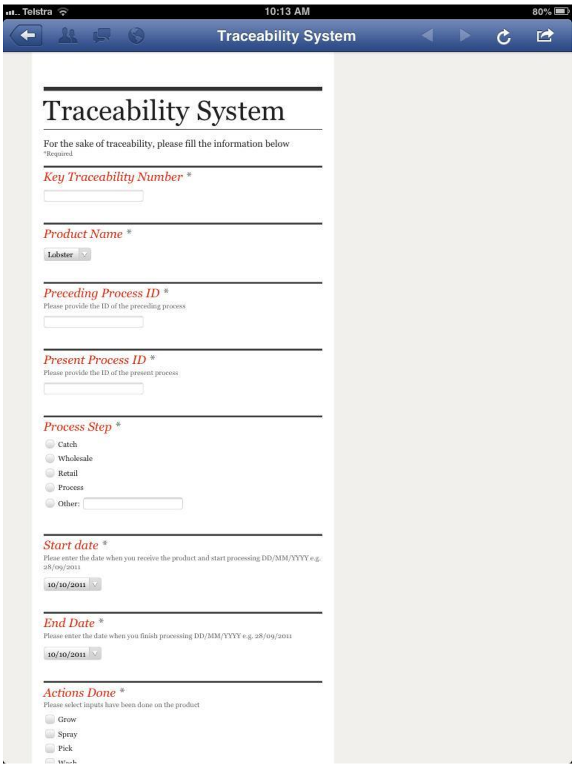

Figure 5-10: Traceability System Front-end Interface

The back-end database permits primary producers and their supply chain members to trace products and share the traceability information in real time. This could be critical in instances such as when an issue of contamination might arise and a recall is required.

As shown in Figure 5-11, the traceability back-end database has incorporated a Google map showing the locations of the supply chain members based on the spreadsheet data. This is a typical sample of a mashup of the Web 2.0 principles. This mashup combines the traceability information and the Google Map data, and creates a new service.

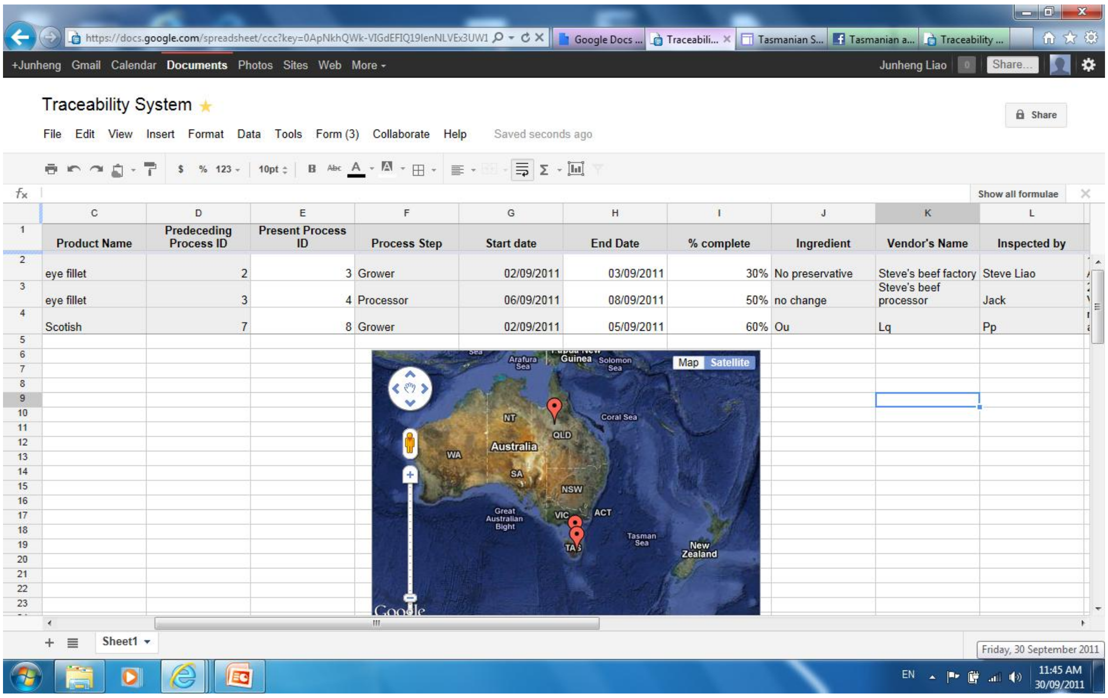

Figure 5-11: Traceability System Database

5.5 FOLLOW-UP INTERVIEWS

The survey interviews were kept as short as possible due to the heavy workloads of the primary producer participants. This made it difficult for the investigator to obtain detailed information. However, once the interview data had been analysed, it became apparent that some supplementary information would enable a richer understanding of the collected data. An amendment of the ethics application was thus sought to allow the collection of some supplementary information.

There were two major reasons for asking the follow-up questions as a second stage survey. Firstly, although the preliminary findings of the 28 usable survey interviews provided very useful information concerning ICT and, more importantly, Web 2.0 use within Tasmanian agri-food supply chains, this information was not sufficient to fully explain the reasons for participants' answers. In addition, the analysis of these findings had identified some new and unexpected issues. These included instances where the information differed from that obtained from the key informant interviews and the literature review. These could only be resolved (or, at least, more fully understood) by gathering additional data.

5.5.1 QUESTIONS IN THE FOLLOW-UP INTERVIEWS

The follow-up questions were designed to capture the following information (see Appendix B).

1) new issues emerging from the analysis of the survey data, e.g. the differences between the findings of the survey and the findings of the key informant interviews, as well as the significant differences in the use of ICT by different agribusinesses in the same sub-sector

2) more detailed insights into motives for / obstacles to the application of ICT to participants' supply chain management. These motives are essential to uncover latent determinants and moderators predicting the acceptance of applying ICT and, more importantly, Web 2.0 to the management of the supply chain.

5.5.2 OVERVIEW OF FOLLOW-UP INTERVIEWS

To begin with, a follow-up email designed to obtain supplementary information was sent to each interviewee who had participated in the survey. The email enquired about the participants' willingness to be contacted by telephone, so as to reduce the time and effort required answering the questions (some of which might have taken a long time to answer by email). Telephone calls were only to be made if the participant concerned indicated agreement. (In comparison with a follow-up visit, a telephone call or email is significantly less intrusive).

The answers were eventually obtained through a variety of methods such as email, follow-up calls and revisits. Ultimately, 13 interviewees participated in the follow-up interviews with four email responses, eight via telephone calls and one by face-to-face. These 13 interviewees covered all of the sub-sectors investigated in this research project.

5.6 CONCLUSION

This chapter described the design of the survey and the follow-up interviews which provided supplementary information to the survey results. The survey design consisted of three main sections – Section 5.2 Survey Administration described the administration of the survey and the selection of survey population and sample; Section 5.3 Design of the Survey Questionnaire described the development of the questionnaire, and especially the literature that underpinned each question; and section 5.4 Web 2.0 SCM Prototype provided detailed information about the development of the prototype; and Section 5.5 presented the reasons, design and administration of the follow-up survey.

This chapter has discussed issues that needed to be addressed before the survey data collection. The next chapter discusses and analyses the findings gained from the survey.

Chapter 6

Survey Analysis

6.1 INTRODUCTION

Chapter 5 described the design and administration of the survey. The survey analysis is described in Chapter 6 and Chapter 7. This Chapter presents an overview of the survey results, and a description of each agri-food supply chain in terms of the ICT and Web 2.0 use; while Chapter 7 focuses on the reasons why the agri-food SMEs either apply or do not apply ICT and Web 2.0 to their SCM.

The structure of this Chapter is as follows: Section 6.2 describes the data analysis techniques used to understand the survey findings. Section 6.3 provides an overview of the survey results such as the participants' profiles and general ICT use. Section 6.4 offers a summary of the agri-food supply chains in which the study participants are involved, with an evaluation of the role ICT and Web 2.0 plays in these supply chains. The final section of the Chapter, Section 6.5, concludes with a summary of the survey findings described in this chapter.

6.2 DATA ANALYSIS TECHNIQUES USED FOR THE SURVEY DATA

There are several different methods or approaches to categorise quantitative or statistical analysis. Along one dimension the approach can be confirmatory or exploratory. Along another dimension the approach can be descriptive or inferential (Krueger 2006, p145).

Confirmatory data analysis is a statistical approach used to obtain and present formal evidence to verify a given theory or hypothesis (Behrens & Yu 2003, p42). Exploratory data analysis is a statistical approach used to analyse a dataset and summarise the main characteristics of the data by means of graphics, as well as to learn from the data (Behrens & Yu 2003; Hartwig & Dearing 1979, p5-6). Tukey (1980), the father of exploratory data analysis, defined this approach succinctly as "an attitude, a flexibility and some graph paper (or transparencies, or both)".

Descriptive statistics and inferential statistics differ in their purpose, and in the way the data are used (Weinberg & Goldberg 1990). The objective of descriptive statistics is to describe the data while inferential statistics aims to generalise the findings from a smaller dataset to a larger group (Weinberg & Goldberg 1990).

Since this is an exploratory research project and the research area is still a green field, exploratory data analysis is an appropriate approach for the survey data analysis (Krueger 2006, p145-146).

Due to limited research resources and the difficulty of recruiting busy primary producers for the interviews, it proved possible to recruit only 28 agri-food SMEs from the survey; and the samples may have been somewhat self-selected. While the dataset here is not adequate to be representative of the entire primary industry, and, more importantly, is not suitable for use in a pure inferential data analysis, descriptive statistics is a valid approach. A recent study (Lawson et al. 2011) has supported the use of descriptive statistics to analyse information systems use in the farming sector.

Although some believe exploratory data analysis can only be achieved by descriptive statistics (Tukey 1980) descriptive and inferential statistics are artificial categorisations which can overlap in their application (Berthold & Hand 2003, p2). An exploratory data analysis largely based on descriptive statistics and with some implications indicated by inferential statistics has therefore been employed for the data analysis.

6.3 OVERVIEW OF SURVEY RESULTS

This Section presents the survey findings along the following dimensions or aspects of the data: demography, agribusiness operations, supply chain overview, communication along supply chains, and ICT use in supply chain management with a particular focus on Web 2.0 use.

6.3.1 PARTICIPANTS' PROFILES

This section includes some basic information about the participants and their agribusinesses, such as participants' age, gender, and their years of experience in primary industry.

6.3.1.1 PARTICIPANT AGE AND GENDER IMBALANCES

Figure 6-1 shows the age distribution of the 28 survey respondents, the majority of whom (78.6%, n=22) were aged between 30 and 59, with only three respondents (10.7%) under 30 and a further three over 60. Thus there was an average age of the mid-40s for participants.

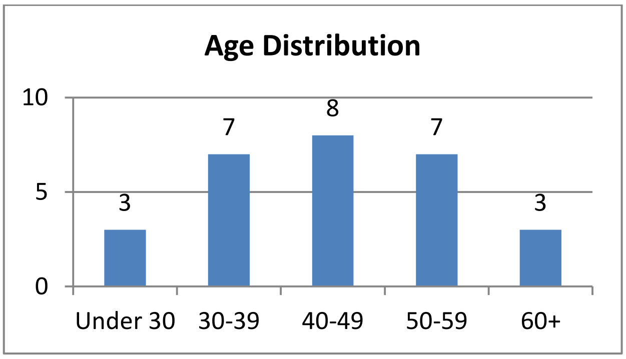

Figure 6-1: Research Participants' Age Distribution

The actual farming population may well be older than the sample of respondents in this research project (Rural Weekly 2012). Both the Australian Bureau of Statistics and the National Farmers Federation have identified an average age of 53 for farmers (ABS 2012; NFF 2012).

The survey data collected should, in the light of the above age distribution, be viewed with some caution, as the sample may differ from the distribution of the overall population because participants in this project tended to self-select. It is not clear how many interviewees volunteered to participate because of their greater computer literacy and interest in ICT, while other farmers with little experience or interest in ICT may have chosen not to participate. Some older farmers who declined an invitation to participate explained that they did not use computers at all for their records, but there is no empirical evidence that older farmers lack computer literacy skills. In the labour-intensive farming industry, the population is significantly older than for any other Australian industry sector. This worrying situation suggests that, without major change, in 20 years' time Australia may not have sufficient farmers to work on the land and produce quality food for Australia and its growing food export market (Hamblin 2012).

In terms of gender balance, only 2 of the 28 participants were female. Although this result might appear to suggest that male farmers or fishermen are the vast majority in farming and fishing fields, the Australian Bureau of Statistics found that 28% of farmers in 2010-11 were female (down from 30% in 1981 (ABS 2012). One possible explanation for the small and rather disappointing female participation rate may be the fact that the majority of the interviewees were family businesses. The female family members are more likely to contribute to the in-house operations of the business rather than being the primary decision makers in small agribusinesses.

6.3.1.2 YEARS OF EXPERIENCE IN PRIMARY INDUSTRY

As depicted in Figure 6-2 the majority of the interviewees (82.2%, n=23) have more than 10 years' experience in the agri-food sector. Only 4 (14.3%) interviewees had as little as 5-9 years' experience and only 1 (3.5%) interviewee had less than 5 years' experience.

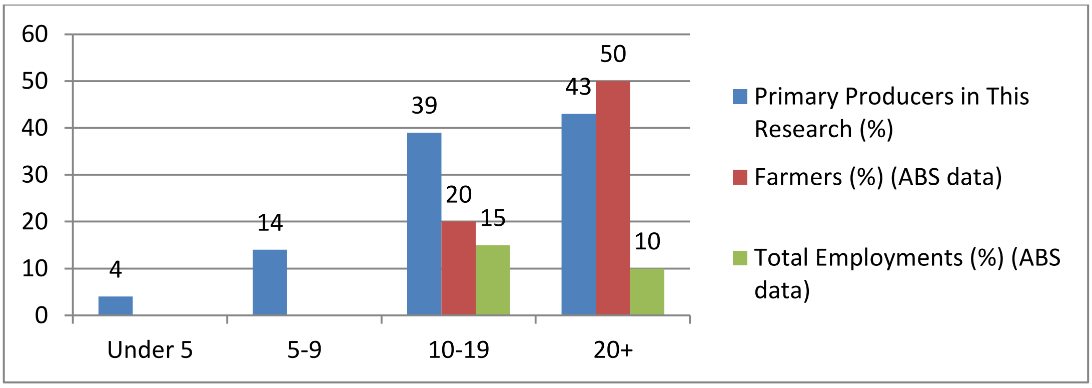

Figure 6-2: Years of Field Experience

The years of experience of the farmers in the sample mirrors the Australian Bureau of Statistics finding that duration of employment is generally longer for farmers than for other occupations (ABS 2012b, p318). Three categories of farmers were identified when farming experiences were surveyed: traditional, hobby, and 'sea change' farmers. Traditional farmers are those who have spent most of their career in farming activities and consider farming their primary occupation and main income source. 22 interviewees were classified as traditional farmers/fishermen. Hobby farmers are those people who operate small farms primarily for pleasure rather than profit. One farmer (VM2) was classified as a hobby farmer as he considered his farming activities more as entertainment rather than as providing his primary income source. Sea change farmers were those who had left urban or non-farming jobs in recent years and was applying their modern management and technology skills to establish agribusinesses. D1, D3, F1, M2 and VM6 were distinguished from conventional farmers or hobby farmers, and were identified as sea change farmers.

These sea change farmers, in general, had good ICT skills and apply ICT more willingly and more frequently to their agribusinesses than the other primary producer groups. For example, D1 and D3 have both used Facebook, professional websites and online stores for their agribusinesses; F1 has applied a range of Web 2.0 technologies such as Facebook, blog and YouTube to his agribusiness; M2 has contributed to the development of a Financial Risk

Assessment application; and VM6 has used a web-based quality report system, McCain AgPortal, to check the outputs of his vegetable supply business.

There are a range of reasons why sea change farmers have chosen the move into agribusiness, including: change of life style, inheriting a family farm, to apply relevant research and advisory experience; and to improve income.

The sea change farmer is a category which has not been specified in the major reports (ABS 2012a, 2012b). The finding that there is a substantial number of farmers with working experience in the service industry suggests that this workforce with their management skills and technology experience could potentially change the face of the agri-food industry. This might, in turn, enable an evolutionary improvement and provide new approaches for the struggling agri-food industry.

6.3.2 AGRIBUSINESS OPERATIONS

The survey results indicated that multiple or diversified modes of farming were common in the surveyed agribusinesses. As shown in Figure 6-3, the interviewees working in the seafood (28.6%, n=8) or dairy (25.0%, n=7) sub-sectors together accounted for more than half of the all participants; however, the farmers' and fishermen's businesses were more diversified than first appeared and the initial categories listed in the questionnaire were not sufficiently comprehensive to allow for their diversified business operations. For example S6 sold crayfish and ran a vineyard; M2 grew livestock, wool and even cultivated poppies; M4 sold both milk and livestock; and VM1, VM2, VM3, VM4 and VM5 grew vegetables and bred livestock. The agribusinesses with mixed vegetable and livestock production accounted for 17.9% (n=5) of the total population. These results are generally consistent with the finding of the ABS that 22% of the total 157,000 Australian farmers grew a mix of crops and livestock in 2011 (ABS 2012a).

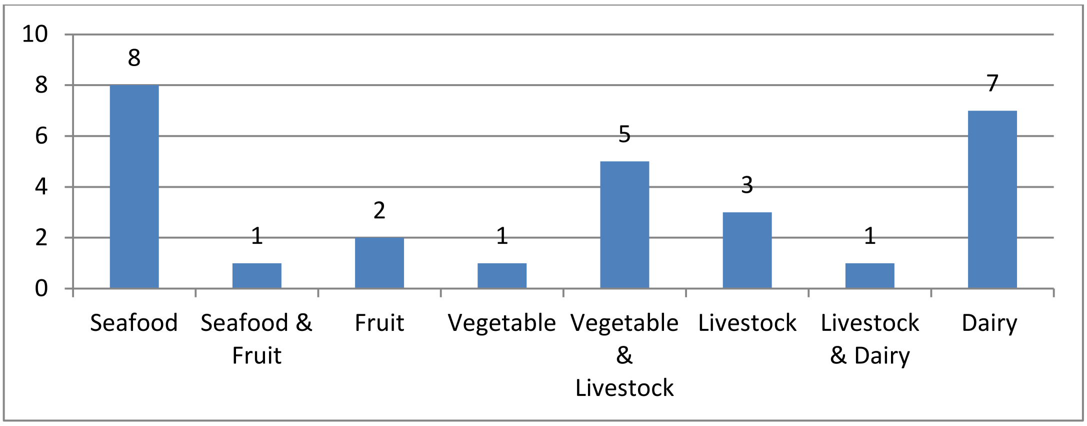

Figure 6-3: Interviewees' Sub-sectors

A number of agribusinesses had extended (or were planning to extend) their operations to include hospitality or tourism services. S1, S7, D1, D3 and F1 have established cafés and offered agri-tourism on their sites, and S4 and M3 were planning to do so. This situation was investigated by Phillip et al. (2010) but has not been identified by government statistics on agribusinesses (ABS 2012a, 2012b).

Three main reasons identified in the survey for agribusinesses to diversify or extend their operations are risk reduction, resource constraints and a need for additional income. VM1 said:

> *"We are involved in many agricultural sectors, producing meat, wool, animal feeds, cereal grains, walnuts, wood fibre and sand. We produce many things so as to protect our business from major price fluctuations in a single commodity or industry, to spread our workload and cash flow out over more of the year. We have areas of land that are only suitable for producing certain things, steep or stony compared to fertile arable land."*

The survey results indicate that product diversification is considered an effective and feasible strategy to overcome the price fluctuations which are common in the agri-food industry, while the products themselves are constrained by the resources available, such as soil quality.

6.3.3 SUPPLY CHAIN OVERVIEW

This Section describes the downstream customers and upstream suppliers of the survey participants. The objective of collecting this information was to obtain an overview of the agri-food supply chain in Tasmania. Since each agri-food sub-sector operates in many different ways, the explicit information of each sub-chain with the supply chain diagrams of each sub-sector is discussed in section 6.4.

6.3.3.1 CUSTOMERS OF THE PRIMARY PRODUCERS

As shown in Figure 6-4, distributors were the most common buyers of the respondents' products (57.1%, n=16), followed by food processors (46.4%, n=13), individual customers (42.9%, n=12) and restaurants, cafes etc. (35.7%, n=10). Food service providers to schools, airlines, hospitals, etc. (0.0%), online stores (7.1%, n=2) and supermarkets directly (10.7%, n=3) are the three least common buyers identified by the interviewees.

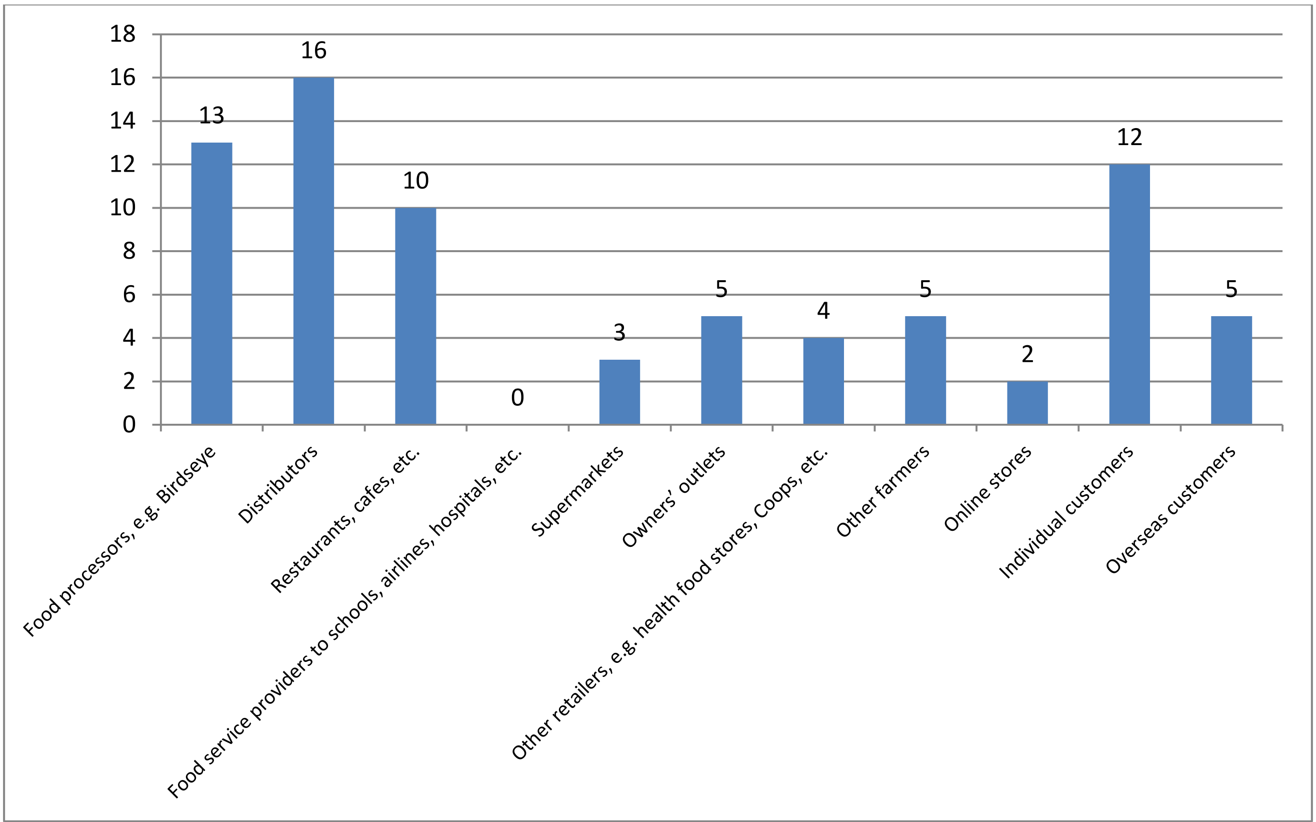

Figure 6-4: Customer Groups

Distributors, food processors, individual customers, and restaurants are identified as the 4 major customer groups for the interviewed primary producers. For clarity, distributors are defined as those companies which purchase primary products from a number of primary producers and resell them to other parties, while processors provide value-added services to the primary products before selling them. In some cases, distributors' activities may overlap with the activities of the processors, as the distributors may process the primary products before selling them. For example, Fonterra Australia, a leading global dairy processor, collects raw milk from a large number of contracted dairy farmers and processes the milk into a range of dairy products that are sold worldwide.

An examination of the breakdown of the sample into the customer groups of the primary producers (see Figure 6-4) indicates that distributors are the predominant customers, while few of the primary producers sell to food service providers, supermarkets, owners' outlets, or other retailers. The breakdown indicates the importance of distributors and processors in the agri-food supply chains. It is interesting to note that supermarkets were not identified as the predominant customers for the primary producers. Only 10.7% of the interviewees identified supermarkets as their customers. There are three possible reasons to explain the high distributor involvement and low supermarket involvement rate.

- Firstly, many primary producers have contact with, and supply to, distributors. The distributors may not share the traceability information with them and therefore the primary producers may not know the ultimate destination of the products even though the products have been sold in the supermarkets after a series of manufacturing and processing activities.

- Secondly, many primary producers were using or were looking for alternative supply channels in order to sell their products as a significant number of the primary producers had lost their earlier contracts with the supermarkets.

- Thirdly, in some sub-sectors, especially lobster and abalone sub-sectors, fishermen or seafood distributors have predominantly supplied to overseas distributors rather than domestic supermarkets.

6.3.3.2 SUPPLIERS TO THE PRIMARY PRODUCERS

The breakdown of the sample data into the supplier groups of the primary producers shown in Figure 6-5 makes it clear that the primary producers have diverse channels through which to purchase their supplies although conventional farm suppliers are still their main source of supplies. Farm suppliers (75.0%, n=21), agrichemical suppliers (71.4%, n=20), hardware stores (64.3%, n=18) and agricultural machinery suppliers (64.3%, n=18) were the top four suppliers indicated by the interviewees. Other farmers or fishermen (50%, n=14), online stores (39.3%, n=11) and individual suppliers other than farmers (39.3%, n=11) were also significant suppliers to the primary producers sampled in this research, while they were less likely to purchase supplies from brokers (32.1%, n=9) or overseas suppliers (25%, n=7). Ship chandlers were identified by 2 fishermen as a category of suppliers additional to those listed in the questionnaire.

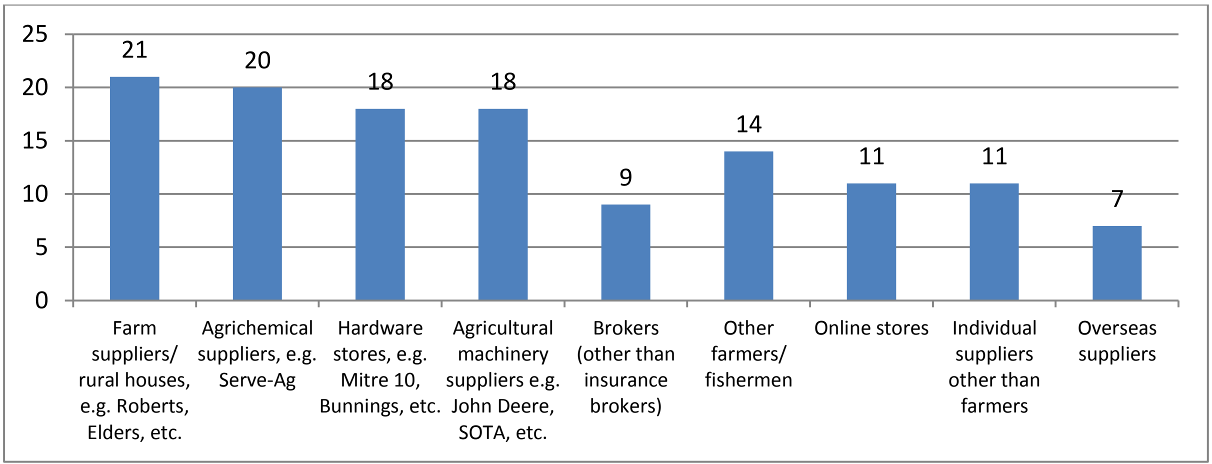

Figure 6-5: Supplier Groups

There are two categories of primary producers in this study: fishermen and farmers. Farmers rely on rural houses, agrichemical suppliers, hardware stores and agricultural machinery suppliers when sourcing farm input; while those fishermen involved in wild catch activities mainly purchase fishing equipment from ship chandlers.

It is interesting to note that 50% of the interviewees claimed they had purchased supplies from other primary producers. Fishermen and farmers purchase a range of products and supplies from their peers for a variety of purposes: fishermen extending their business into distribution purchase seafood products from their peers to increase their stock and enrich their product lines; in the dairy industry, dairy processors purchase raw milk from dairy farmers and process them into a variety of dairy products; the livestock farmers purchase surplus livestock from other farmers for fattening, as well as hay and silage to feed their animals. Primary producers also obtain supplies such as fencing, materials, fertilisers, feedstock and seeds from some smaller suppliers such as single owner businesses as well as purchasing from mainstream farm supply companies.

It is by no means uncommon for primary producers to purchase supplies online. 39.3% (n=11) of interviewees indicated that they had purchased supplies from online stores.

Given the diversity and complexity of the agri-food supply chain and the significant differences between sub-sectors, these examples can provide only a general and limiteed understanding of the agri-food industry. More detailed information about the agri-food supply chain is discussed by sub-sector in Section 6.4.

6.3.4 COMMUNICATION ALONG THE SUPPLY CHAIN

This Section presents the current state of the communication methods used by the primary producers who were interviewed. Details include the primary producers' degree of satisfaction with their existing communication methods; and the reasons for their satisfaction or dissatisfaction.

6.3.4.1 POPULARITY OF COMMUNICATION METHODS

In order to obtain a comprehensive view of their communication methods, interviewees were asked how they communicated with their suppliers, customers, brokers and transport companies. In particular, interviewees were asked to list their usage of the various communication methods in order of frequency.

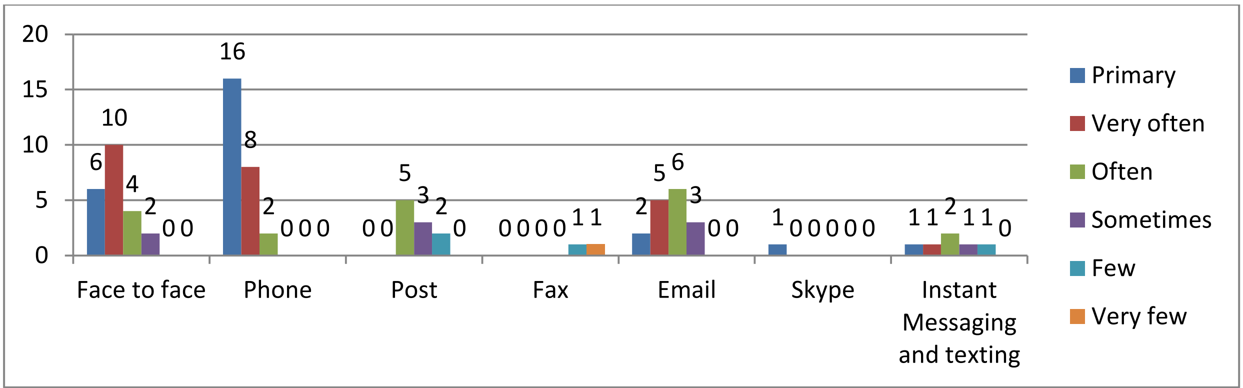

Figure 6-6: Communication Methods to Customers

The results depicted in Figure 6-6 show that all interviewees (100%) use telephone, mobile phone and face-to-face communication. In communicating with customers, phone and face-to-face jointly accounted for 78.6% (n=22) of interviewees' primary communication modes. Similar results were found for communications with suppliers, brokers and transport companies: phone was the most popular way to communicate with trading partners in the agri-food supply chains, with Face-to-face being the second-most popular communication method. Email was an increasingly popular approach though instant messages and texting are emerging sets of ICT technologies. Post is still being indicated as an important communication method but no longer the primary one, while few interviewees chose fax as a communication method. Surprisingly, Skype, the free voice software, had few users - only one seafood processor chose it as the primary method to communicate with overseas customers in the questionnaire; and one further interviewee mentioned Skype in the follow-up interview.

Nonetheless the following comment from S5 suggests that communication in the agri-food supply chain may be moving from telephone calls to ICT base such as email, Skype and texting:

> *"We use email and Skype (especially its texting function) to communicate with the overseas customers, and all sales to China are made by ICT. The customers do not ring anymore and we do not answer phones either. Answering the phone is very time consuming. We could be doing something else. We need personal contact at the first time, but the subsequent contacts could be done by ICT. We still talk to the fishermen over phones. It does not mean fishermen prefer the human interaction but just because they do not have Internet access on board. The fishermen are also starting to use text rather than making phone calls"*

6.3.4.2 DEGREE OF SATISFACTION ABOUT EXISTING COMMUNICATION METHODS

In terms of satisfaction/dissatisfaction with existing communication methods (see Figure 6-7: Degree of Satisfaction with Existing Communication Methods) none of the interviewees (0.0%) was dissatisfied with existing communication methods; 39.3% (n=11) were "very satisfied"; 42.9% (n=12) were "satisfied"; and 17.9% (n=5) had "mixed feelings.

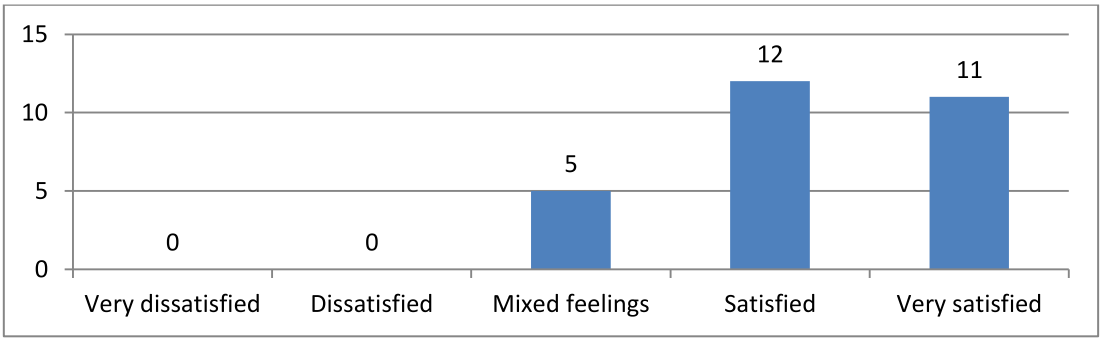

Figure 6-7: Degree of Satisfaction with Existing Communication Methods

This finding makes it clear that the primary producers surveyed have not had any reason to reconsider their existing communication methods. The positive aspects of the existing communication methods were characterised by the interviewees as: easy-to-use, cost effective, efficient and suitable for their working environment. Nonetheless, some weaknesses were identified and can be summarised as: lacking a record of contacts, lacking a networking function and lacking suitable devices for use on site. In addition, poor telecommunication infrastructure has been criticised as a significant barrier for the adoption of ICT.

6.3.5 GENERAL INTERNET USE

This Section discusses general Internet use, NBN adoption, website ownership and Web 2.0 applications by the primary producers.

6.3.5.1 INTERNET USE AND NBN ADOPTION

It became clear all the farmers and fishermen were using the Internet in their businesses even though some respondents originally claimed they had not done so (although one interviewee originally responded "Not using", for example, this was contradicted by the information obtained during his interview). Since most of these agribusinesses are family business there are two possible reasons for this apparent contradiction: firstly, there is no clear border between personal use and business use, which may well have confused this particular participant; and secondly, some of the interviewees have not been able to apply ICT to their the business themselves and rely on family members to help them with its use. S6 said:

> *"Why don't I use Internet? Because I don't understand the Internet, I am just starting to learn how to use computer…my daughter knows how to use the Internet."*

Of the 28 Internet users, 5 indicated that they used the NBN. However three of these answers seem likely to be incorrect because, firstly, their location had not yet been reached by the NBN rollout at the time of the interview; and, secondly, because they did not have a good understanding of what NBN really was and might well have confused the material available in the newspaper with what was actually occurring. Only 2 participants could be verified as genuine NBN users.

6.3.5.2 WEBSITE OWNERSHIP

While all the agribusinesses surveyed use the Internet only 4 of them (14.3%) had websites of their own. Ownership of an online presence is found in dairy, fruit & vegetable and seafood but not in the livestock sub-sector. The result may be explained by the fact that meat must be processed in specialised factories and end-use customers do not expect to buy meat directly from livestock farmers due to government regulation. Since livestock producers are not going to sell their meat directly to end-customers, they have apparently not considered it worthwhile to create an online presence connecting themselves to a large number of customers, a view supported by the fact that all four of the businesses with an online presence cater for a large number of individual customers.

Online presence is considered a more sophisticated level of Internet use and has the potential to bring a range of benefits to agri-food SMEs (Prananto et al. 2003a, 2003b; Simmons et al. 2007). The limited use of an online presence in this study suggests, therefore, that the use of the Internet is still rudimentary in the Tasmanian agri-food industry. It also suggests that conventional websites may be less useful for some groups of primary producers (especially those who deal directly with a small number of large customers); or perhaps the effort in establishing and managing the website overshadows its usefulness.

6.3.5.3 USE OF WEB 2.0 APPLICATIONS

All interviewees had used some Web 2.0 applications but only a small number actively engaged in content contribution and few of these had applied Web 2.0 to their businesses. As shown in Figure 6-8, of the nine Web 2.0 applications in the questionnaire, all interviewees (100.0%, n=28) stated that they used search engines and none used Google Docs (0.0%, n=0). Google Map was the second most popular Web 2.0 application, with all but one respondent using this application, followed by YouTube (71.4%, n=20), Facebook (64.3%, n=18) and Wikipedia (60.7%, n=17). Perhaps surprisingly, few interviewees used blogs (21.4%, n=6), Podcast (21.4%, n=6) or Twitter (14.2%, n=4).

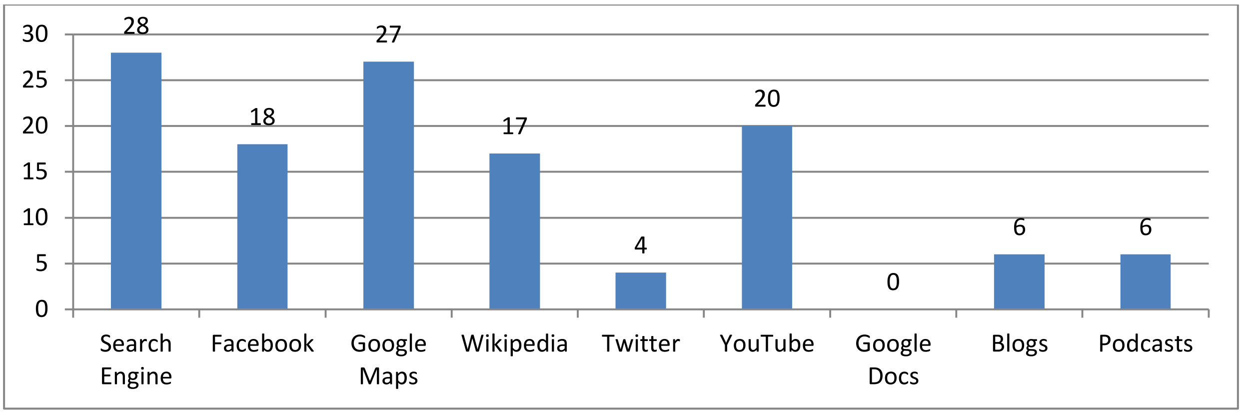

Figure 6-8: Use of Web 2.0 Technologies Found in this Research

The survey data indicated that Web 2.0 applications were divided into two groups in terms of user numbers: those respondents using blogs, podcasts, Twitter and Google Docs was significantly fewer than those using a Search engine, Google Maps, YouTube, Facebook and Wikipedia. One possible explanation for this difference is the degree of content contribution. The first group of Web 2.0 applications require more input, content contribution and information sharing; while the majority of the latter group of applications require far less contribution from users. Even though Facebook is input oriented, it does not require constant input to be useful (many Facebook users, for example, simply 'lurk and watch their friends' contribution, or 'like' other people's contributions rather than adding material of their own). These findings suggest that the use of Web 2.0 applications is still largely limited to information search, indicating passive use of Web 2.0, while the use of applications requiring active contribution is minimal. The findings also suggest that the popular social application, Facebook, has the potential to act as a transitional tool so that predominantly passive users can evolve into more active content contributors.

These findings can be compared with earlier research into use of social communication technologies by agri-food SMEs (Burke 2010) (see Figure 6-9). Burke (2010) investigated the adoption and use of ICT by small and medium sized primary producers, surveying 422 farm businesses including flower growers, fruit and vegetable farmers, plant and foliage growers and farmers growing other crops such as coffee and macadamia nuts in Hawaii, and receiving 109 usable replies.

The use of these Web 2.0 applications by survey participants, in this research, in general, was high and indeed much higher than the uses reported by Burke in 2010 although the use of blogs and podcasts found in this study was limited. Comparisons between these two studies, however, should be viewed with caution, as there are likely to be differences due to the sub-sectors in which Burke's SME participants were involved vis-à-vis the present research project.

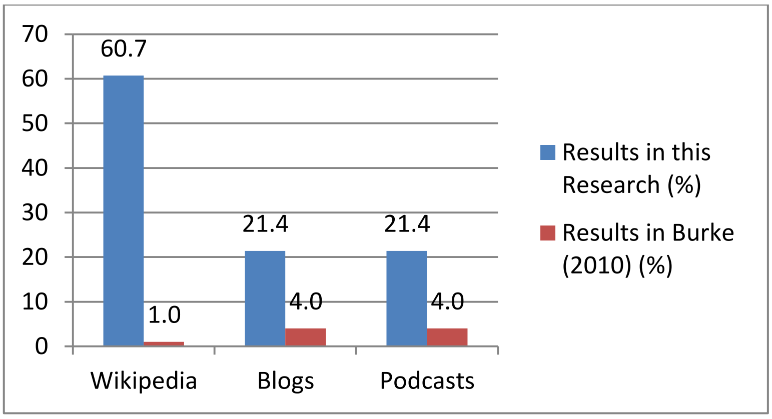

Figure 6-9: Comparison of Web 2.0 Adoption Rate

In addition to the social media use identified by Burke (2010), this research project has also found primary producer use of a range of Web 2.0 technologies including: search engine, Facebook, Google Map, Twitter and YouTube.

6.3.6 EXISTING ICT USE IN SUPPLY CHAIN MANAGEMENT

The analysis of the survey data according to the ICT applications used by the primary producers for supply chain management (Figure 6-10) showed that email (89.3%, n=25) was the predominant ICT application used in SCM activities, providing a basic and very easy-to-use method for primary producers to manage their supply chain activities. Further analysis revealed that 8 interviewees (28.6%) had used Web-based platforms to manage their online trading, and 5 interviewees (17.9%) claimed they had used software systems provided by their trading partners for the purpose. Overall, these results indicate that the ICT applications used by the primary producers for SCM, dominated as they are by basic email, are still at very low levels of complexity.

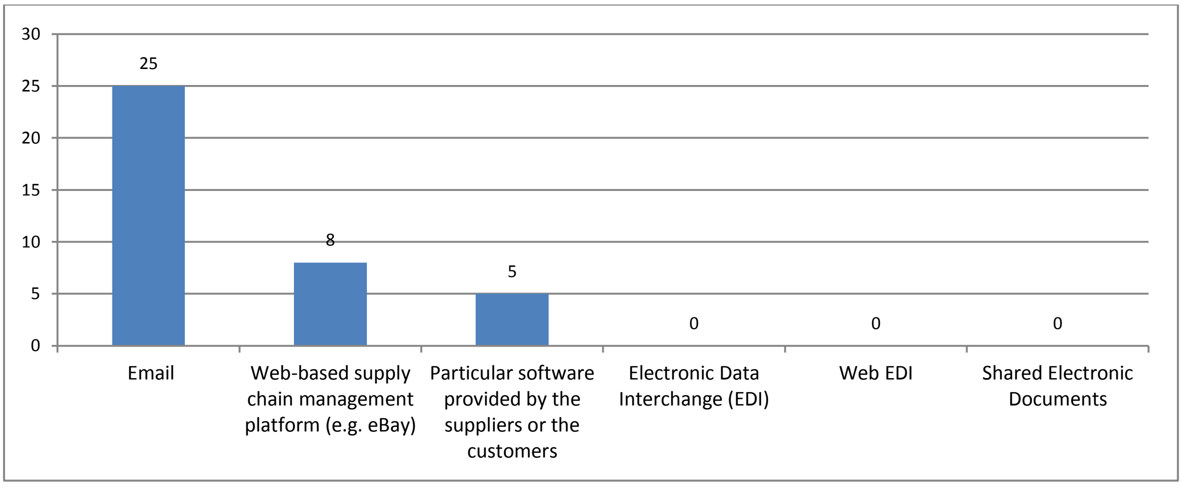

Figure 6-10: Applications used for SCM

Despite the predominance of email, a range of SCM application systems used by the primary producers was identified. These systems are briefly described in Table 6-1.

Table 6-1: SCM Applications used by the Primary Producers

Name	Function	URL
AuctionsPlus	An e-marketplace enabling livestock farmers to trade their animals	http://www.auctionsplus.com.au/
National Livestock Identification System	A national system for identification and traceability of livestock in Australia	http://www.mla.com.au/Meat-safety-and-traceability/National-Livestock-Identification-System
Dairy web	An web-based application enabling dairy farmers to check their raw milk results	https://web1.dairyweb.com.au/
ALPRO	An information management system developed by DeLaval Company to enhance dairy farm management	N/A
McCain AgPortal	An online application provided by McCain Foods (Aust) Pty Ltd for vegetable growers to check their product result	http://agportal.mccainagportal.com/
Myfoodlink	An online grocery system designed for small agribusiness wishing to sell their produce online	http://www.myfoodlink.com/
Star-track	A web-based logistic management system to enable users to submit delivery details and trace delivers online	http://www.startrackexpress.com.au/online-tools/freightmaster/

It is surprising, yet encouraging, to discover that the majority of the software provided to farmers by trading partners is now web-based. This does, however, mean that their answers need to be interpreted with caution since "Web-based supply chain management platforms" and "Particular software provided by the suppliers or the customers" may now overlap with one another. The data analysis indicated that the SCM applications used were evolving into web-based applications and, since 'Web as a platform' is an important principle of Web 2.0, the ICT used by agri-food SMEs could well be considered as Web 2.0 use.

6.4 ICT AND WEB 2.0 USE IN DIFFERING SUPPLY CHAINS

An overview of each supply chain and the ICT use in each supply chain was provided in Chapter 4. In the early sections of this Chapter the survey findings, largely based on the quantitative data, have provided more detailed information. However, there was also a considerable amount of emerging and significant detail that has not thus far been included. This Section therefore analyses the predominantly qualitative findings from the survey which variously confirm, contradict and, more importantly, supplement those findings already discussed.

This Section reports on ICT (and especially Web 2.0) use in agri-food supply chains and includes contextual information. The reports of ICT use are arranged in terms of the key activities and processes it supports in the supply chains. Cooper et al. (1997) identified the eight key processes of general supply chain management as:

- customer relationship management;
- customer service management;
- demand management;
- order fulfilment;
- manufacturing flow management;
- procurement;
- product development and commercialisation; and
- returns

Matopoulos et al. (2007) summarised the activities in an agri-food supply chain made up of large producers as comprising:

- procurement;
- inventory management;
- product design and new product development;
- manufacturing (planning);
- order processing;
- transportation/distribution;
- sales;
- demand management; and
- customer service.

Since the operations of those agri-food SMEs participating in the survey were considerably simpler than those companies reviewed by Matopoulos et al., however, this categorisation was not relevant in its 'vanilla' from. To improve its usefulness for evaluating the SCM activities of small primary producers, therefore, the categories were re-organised with obviously irrelevant activities being removed or modified.

To simplify this classification, the umbrella term 'order processing, inventory management and planning' was created to cover the relevant activities comprising order processing, inventory management, demand management and planning. A second change combined 'customer relationship management' and 'customer service management' into a single category as 'supplier and customer relationship management'. Finally, the competencies of 'product design' and 'new product development' were not measured, and thus are not discussed in this Section.

These changes resulted in a modified agri-food supply chain classification made up of the following categories:

- procurement;
- marketing and sales;
- order processing, inventory management and planning;
- transport and distribution; and
- supplier and customer relationship management.

Although there are similarities between the sub-chains investigated in this project, each of them has unique characteristics. It is therefore necessary to discuss the characteristics of each individual supply chain investigated and present the findings by sub-sector within each supply chain activity. In this project, the primary producers are the focal point. Their downstream supply chains are the main focus; and their upstream supply chains (such as farm supplies and agrichemical supplies) are considered less important because all participants' upstream suppliers are very simple and similar and, thus, do not require individual elucidation.

The survey findings show that only a few primary producers in this sample had used ICT and Web 2.0 for sales and marketing activities as well as for customer service, and even fewer had applied this technology to other supply chain activities. It is encouraging to discover, however, that an increasing number of Web 2.0 technologies, especially those were used mainly for personal communication and entertainment before, have gradually been applied to their SCM.

6.4.1 ICT AND WEB 2.0 USE IN THE SEAFOOD SUPPLY CHAIN

The seafood supply chain was characterised as 'export oriented' and 'quota-constrained' by the interviewees, who noted that distributors play an important facilitating role in this supply chain. ICT use was limited and rudimentary in this sub-sector: supply chain participants' communication was dominated by phone and email, while their catch and inventory record was largely paper-based although some of them used Microsoft Excel to record details. There are some encouraging exceptions to this lack of technology expertise, however. One fisherman who had extended his operation beyond fishing to distribution was using a range of ICT technologies and systems (especially Web 2.0) to improve his supply chain activities; another fisherman had developed an iPhone app, named iFish, to manage his record-keeping and traceability; and an oyster fisherman was operating his own website to promote his business.

The seafood supply chains surveyed in this research project can be further divided into two separate supply chains due to their differing market focus: the southern rock lobster and abalone supply chain, and the oyster supply chain. The 'southern rock lobster and abalone' supply chain focuses on overseas markets and normally involves only wholesale transactions while the oyster supply chain focuses on retail transactions and the local market. Since the oyster supply chain investigated was simple and short and there was a single interviewee (S7) who worked in the oyster sub-sector, this Section will now focus on the southern rock lobster and abalone supply chains exclusively.

In the seafood sub-sector, ICT and Web 2.0 applications were found in different supply chain activities. In contrast to earlier findings by Richards (2006), however, there were an emerging set of Web 2.0 technologies which have been applied to enhance activities in the seafood supply chain. The ICT and Web 2.0 applications in the seafood supply chain are summarised in ‘Table 6-2: ICT and Web 2.0 Applications in the Seafood Supply Chain’, where the typical Web 2.0 applications are highlighted.

Table 6-2: ICT and Web 2.0 Applications in the Seafood Supply Chain

Main Supply Chain Activities	ICT and Web 2.0 applications
Procurement	email
	Online shopping
Marketing and sales	email
	Online store
	Conventional websites
	YouTube
	Facebook
Order processing, inventory management and planning	**Online store**
	iFish app.
Transport and distribution	email
	email
Supplier and customer relationship management	email
	Skype
	Facebook

More detailed information about ICT and Web 2.0 applications in the main supply chain activities is given below.

6.4.1.1 PROCUREMENT

Unlike some other agricultural sectors where there are significant purchasing requirements, primary producers in the wild catch fishing sector do not need to purchase much farming input, except for hooks and nets for fishing. By contrast, S7 (who runs a marine farm) sources a wide range of supplies through a number of supply channels and online stores are considered to be a time-saving channel for purchasing products that are not perishable. There are still only a small number of fish management suppliers online, however, and online purchasing has not yet become popular with the fishermen sampled, who were still comfortable with their traditional method of procurement; visiting the chosen store in person.

The unit quota system is a distinct and important part of the wild catch sub-sector of the seafood industry (Richards 2006). The annual quota is around 1,000 tonnes for southern rock lobster and is shared by 200 boats according to S4. The quota is critical for fisherman and is a major part of their ongoing expenses. S2 said:

> *"If you do not record your catch properly they will take your license and take your house…being a small fisherman you need to own the quota. 1 in 4 tonnes catch is needed to cover the cost of the quota."*

It was surprising to find that quota trading still relies on personal contacts and that there is no online trading platform to support this trade. An online quota trading platform, which was suggested by S2, might well provide an effective way for fishermen to match demand and supply; and would not only improve the efficient use of available quota, but would also provide further experience in the use of ICT for core business activities, which might encourage its use in other aspects of procurement.

6.4.1.2 MARKETING AND SALES

S7 operates a marine farm with a size of around 150 acres in regional Tasmania. He has used a conventional website to promote his business and attract visitors to his on-site seafood bar but, constrained by limited production and limited products, his agribusiness did not have sufficient volume to support online sales. Insufficient supply was seen as an obstacle to his engaging in online sales.

In the rock lobster and abalone sub-sectors, the fishermen and seafood distributors were aware of the risk and uncertainty caused by their total reliance on overseas markets (Richards 2006). Some intended to reduce this reliance by exploring the domestic market. In addition to his on-site café, S1 is looking to enhance domestic sales of his produce and has used a range of ICT platforms and solutions to explore potential domestic demand. These platforms/systems included; a Facebook page, a professional website and an online order system. Many researchers have mentioned that e-commerce was useful for exploring overseas markets (Gregory et al. 2007; Mathews & Healy 2006), but the findings in the present research project suggest that e-commerce (especially Facebook-Commerce which embraces social networking and word-of-mouth principles) may be an effective tool for exploring local and community markets.

6.4.1.2.1 DISTRIBUTORS AS FACILITATORS IN THE SEAFOOD SUPPLY CHAIN

In the seafood industry, the majority of products are exported to offshore markets as overseas customers are willing to pay much higher prices than domestic customers (Richards 2006). The distributors play an important facilitating role in the seafood supply chain, managing the marketing activities and most of the paperwork, while the fishermen are busy with fishing activities. In addition, the distributors accept the financial risk in dealing with overseas customers. The distributors were considered to be important middlemen, facilitating trade that would be a challenge for the fishermen themselves to manage. S2 said:

> *"The middleman is the "lifter and shifter" but they are organising the supply chain and they are a part of the supply chain…I rarely deal with the individual customers as it is too hard to deal with small amount…if I go home and put up the advertisement to sell to the public, it may cost me 5 days fishing and 10 days selling? What if I can't sell?"*

Describing the distributors' role in the supply chain, S5 said:

> *"The fishermen need a marketer and processors who pack them (crayfish) and ship them to the end customers. There is still a lot of work to get stocks to overseas markets. You need experience and time to do this. The fishermen are very busy with fishing and have no experience and time to do that."*

Usually the distributors purchase product from fishermen and supply to other customers in large volume. As depicted in Figure 6-11, 8 out of the 9 interviewees in the seafood sub-sector sold their product to processors/distributors. The term 'distributors' is used here to represent the operations of both processors and distributors. There were 6 large and 44 small distributors in the lobster supply chain, and 6 large and 35 small distributors in the abalone supply chain in Tasmania although, as some distributors handle both lobster and abalone products, the numbers may include some overlap. These findings confirm the reliance of effective supply chain operation on distributors originally described in the Key Informant Interviews and help to explain why there is so little use of ICT and/or Web 2.0 in this sector.

In markets where middlemen take on much of the risk and many of the activities associated with sales, there is little genuine incentive for individual producers to put time, effort and money into developing technology solutions of their own – they can simply sell their produce (in this case, their catch) to the distributors.)

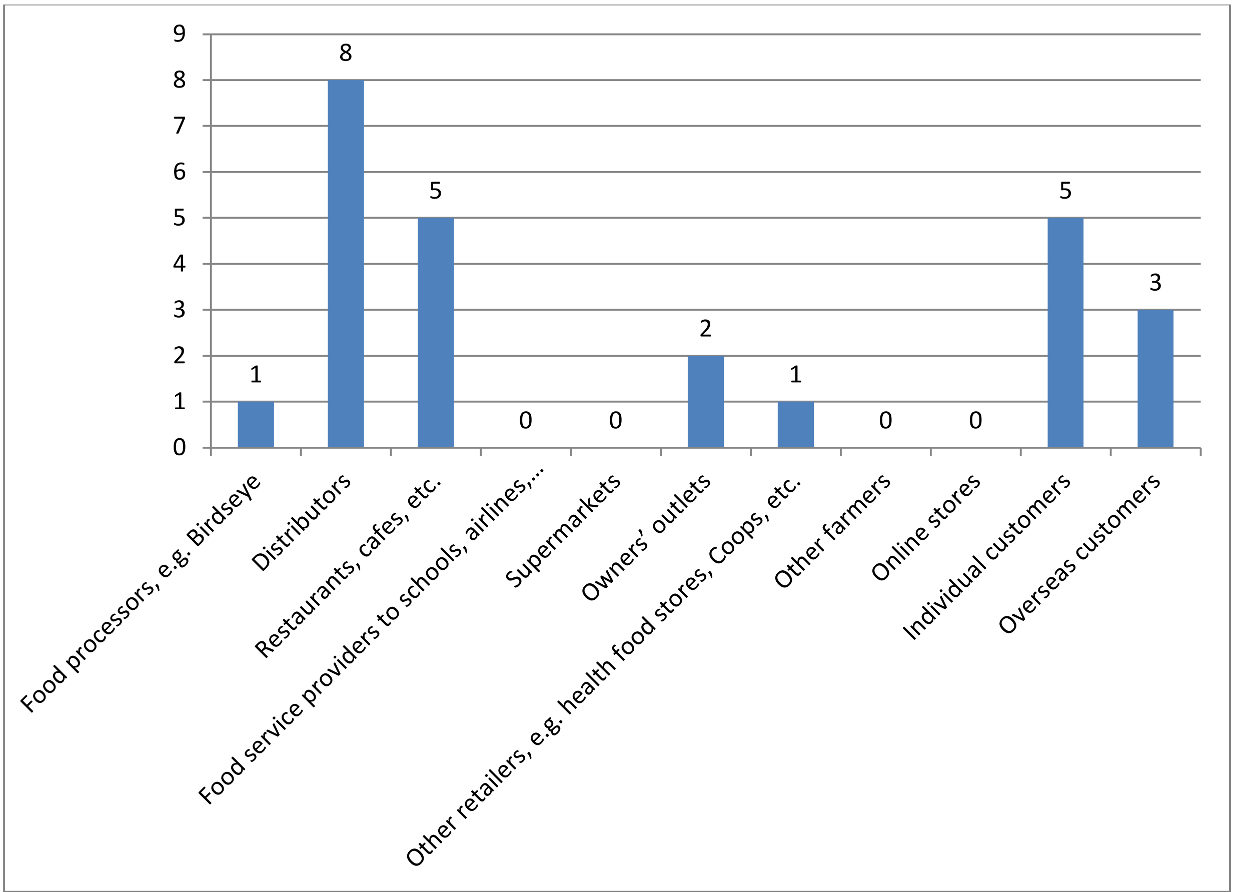

Figure 6-11: Customers of the Interviewees in Seafood sub-sector

6.4.1.2.2 WEAKNESS OF THE EXISTING SUPPLY CHAIN

The existing export-oriented and highly concentrated supply chain was not without weakness. Long credit periods and the general costs and imposts of international trade, such as custom clearance and import tariff, were the two main concerns. It is common to offer a particular credit period (around 7 days) for overseas distributors to settle balances, but this can sometimes lead to a lengthy amount receivable period or even to bad debts. Regarding this issue S5 complained:

> *"Our revenue in last year is still owed $0.5 million by others."*

Since approximately 90% of the southern rock lobster and abalone catch has been exported to overseas markets, especially to China over the past few decades, international markets and export performance are critical for the lobster and abalone industry. There is substantial risk and uncertainty in engaging in international trade under the current situation because a significant percentage of these traders have not paid the required import tariff (ABC News 2011a). For example, immediately before the Christmas peak season in 2010, a sudden crackdown by Chinese authority forced already-caught and highly perishable lobsters to be sold locally at half the price normally obtained in the export market, with serious results for Tasmanian fishermen (ABC News 2011a).

6.4.1.2.3 Exploration of Domestic Markets via ICT and Web 2.0

The local seafood producers are only too well aware of the challenges of concentrated customer groups and tariff issues in international trade and would very much like to diversify their customer groups (Richards 2006). The survey data indicate that Australian restaurants, cafés and individual customers are also important customers after the distributors/processors. 5 of the 9 interviewees indicated they had sold seafood products to Australian and local restaurants, and to individual customers directly, although this was not easy to achieve.

Following the initial survey, S1 became aware of the business potential of Web 2.0 applications and decided to apply this to his own business. A combination of online services including Facebook, a web-based online order system, a conventional website and YouTube videos are now being used to promote his business and, in particular, to explore the local and retail markets.

Many fishermen believe ICT use may only make their life harder as they believe it requires considerable time and effort to understand and use. Fishing is considered a simple operation that suits their lifestyle and provides an acceptable income. Paper-based log books for record keeping as well as phone and radio for communication are, they believe, enough for them to manage their simple supply chain. This perception partially explain the situation that prevails: that is, despite the popularity in some other sectors, online sales of seafood are still in their infancy and online sales channels are not considered a viable option for many suppliers working in the seafood industry due to their time-consuming and potentially unprofitable features.

6.4.1.3 Order Processing, Inventory Management and Planning

There was limited and rudimentary use of ICT by fishermen or distributors to enhance their performance in order processing, inventory management and planning. The majority of the interviewees, especially the fishermen who focused on basic fishing activities and handed over the rest of supply chain activities to distributors, considered the order processing, inventory management and planning processes too simple to justify the use of ICT. To some extent the use of ICT was regarded as a burden on their operations.

Although very few ICT systems were used by survey participants for these processes, there was the occasional example of useful ICT based systems, such as one system (www.myfoodlink.com) covering order processing and inventory management used by an online store and the iFish app for inventory record keeping already mentioned which were detected in the survey.

According to S1, the system (www.myfoodlink.com) means that a large volume of business data, previously recorded in a paper-based system, can now be stored electronically. Although the data currently only involve online sales, the web-based application permits him to move a step towards ICT-enabled SCM, and to record, view, sort and compare data, which supports the making of business decision.

S8, a young fisherman, developed the iPhone app, named iFish, to calculate and record his catch. The app has had two versions since its creation: the original version, shown in Figure 6-12, focused on calculating and recording catch data and on transmitting this information via email to processors or end customers.

Figure 6-12: iFish

In a follow-up interview, however, S8 presented an upgraded version of the iFish app which now incorporates a traceability function. The upgraded version permits him to mark his fishing location using Google Maps. A snapshot of the upgraded version is shown in Figure 6-13.

Figure 6-13: Fishing Locations in iFish 2

The iFish app is ideal for fisherman, in particular lobster fishermen, to improve record keeping and reporting requirements largely because the developer was himself a fisherman with insight into the industry and an understanding of fishermen’s real ICT needs.

The development of iFish was motivated by the need to find a suitable replacement for a paper record which takes time to write down and is difficult to keep (especially on a small boat at sea). The programming skill required for the development was acquired by self-education, in particular by viewing some demonstration videos on YouTube. S8 said:

> *"It is very boring when I anchor up for the night, so I use Facebook to talk to my friends and watch YouTube to learn how to develop iPhone apps."*

The use of any ICT solution in the industry will not, however, achieve truly satisfactory outcomes until the whole industry has agreed on common standards for the systems and is prepared and ready for their deployment. For example, the iFish app developed by S8 has not yet been able to communicate with any seafood processors or customers, even though it is technically capable of doing so. Moreover, although the iPhone app has the potential to overcome the difficulties involved in reporting catch data in real time, corresponding parties such as the government and the marine police will not accept the app and the electronic data stored in it in their present form, requiring the continued use of paper-based records. S8 complained:

> *"The marine police gave me a warning as I had not transferred all the data into the paper-based log book from my iPhone. They will not recognise the data until the app developed by government is operational, which is many years away."*

In summary, the analysis of the survey data suggests that ICT and Web 2.0 applications have real potential to enhance fishermen's performance in the order processing and inventory management domains. However the findings also indicate that effectively employing ICT applications is not merely a matter of resources or technology competence, but is also affected by other external factors such as industry readiness, a finding which is consistent with other similar research (Molla & Peszynski 2011).

6.4.1.4 TRANSPORT AND DISTRIBUTION IN THE SEAFOOD SUPPLY CHAIN

The distributors usually organise transport and collect produce from fishermen at the ports. The produce is delivered to interstate distributors or overseas customers by air freight. Communication regarding transport arrangements is largely by telephone and email.

Regarding direct sales to end consumers the survey findings indicated some challenges related to the transport service. The delivery of perishable goods is time-critical so the conventional Australia Post delivery service is not suitable. The postal service will not ensure that the customer will receive the products in 24 hours as they have a policy to return products to the post office if nobody is at the nominated address to receive the parcel. As a result, perishable products may deteriorate in transit.

Transport and logistics issues were considered by S1 to be an important factor in his decision to adopt an online sales approach. The distribution centre of his business is close to the airport and this enables him to deliver the products to a reasonable proportion of individual customers within an acceptable timeframe.

In the future S1 has many new ideas regarding how he can apply more ICT to his business, such as introducing tags with a traceability function to the products which will thus allow customers to see where his lobsters and abalone are caught. He may be able to achieve this by collaborating with the young fisherman who developed the iFish app.

In summary, the logistics challenges uncovered in the seafood sector by the survey suggest that significant collaboration including agreement on ICT system standards is required to achieve the efficiency and effectiveness of an ICT enabled supply chain.

6.4.1.5 SUPPLIER AND CUSTOMER RELATIONSHIP MANAGEMENT

The processors/distributors rely on the fishermen to supply them with the fish. For their part, the fishermen depend on the processors/distributors to complete the sales. Personal relationships and, in particular, trust and integrity are therefore important between the fishermen and the processors/distributors. S6 indicated the importance of trust and integrity in the supply chain relationship:

> *"The processors are reliable otherwise we won't sell the fish to them anymore."*

Over time the local processors/distributors have established good relationships based on trust and integrity with fishermen, enabling their collaboration which is aimed at long term relationships and being mutually beneficial. S2 said:

> *"I don't sort the catch but the processors do. Integrity is important between us. The fishermen know the weight of the catch by experience. I usually deal with one or two processors. The loyalty is important for me when the market is in trouble such as I know the processors will take my fish when there is border*

issue…I got a new buyer this year, they guarantee the purchase, guarantee the sale though lower price."

Social networking functions have considerable potential to create a beneficial mutual communication mechanism between customers and the agribusiness, which in return promotes sales. This is demonstrated by the case of S1: using Facebook, S1 can easily manage the online page without IT support and, more importantly, communicate with a range of customers in real time. The real-time information enables his customers to gain a better understanding of stock availability and opening hours. Mutual communication enables S1 to better understand customer profiles and customer requirements, which permits him to make more effective decisions to fulfil their requests. The statistics presented in Figure 6-14 show visitor profiles and the performance of the Facebook page of S1.

Figure 6-14: Statistical Analysis of S1's Facebook Page

The social network function also assists S1 to gain exposure and strengthens his connection with the local community. In late December 2012, bushfires broke out across Tasmania and caused serious damage across the State. S1 posted a status update offering a refrigerated van to the community, and this attracted nearly ten times as many visitors as usual to his Facebook page. This result is indicated by the 'Most Popular Week' in the Figure 6-14. The community engagement has helped the business gain exposure and contributed to his gaining a good reputation in the local community.

In summary these findings suggest that Web 2.0's social networking features have great potential to enhance supplier and customer relationships which is important for the sub-sector.

The findings also indicate that Web 2.0 use provides an analytical tool which can be used by the agribusiness to enhance its business decision-making.

6.4.1.6 THE REFINED SEAFOOD SUPPLY CHAIN DIAGRAM

Based on the findings gained from the seafood sub-sector, the supply chain diagram for this sub-sector was refined and the revised diagram is shown in Figure 6-15.

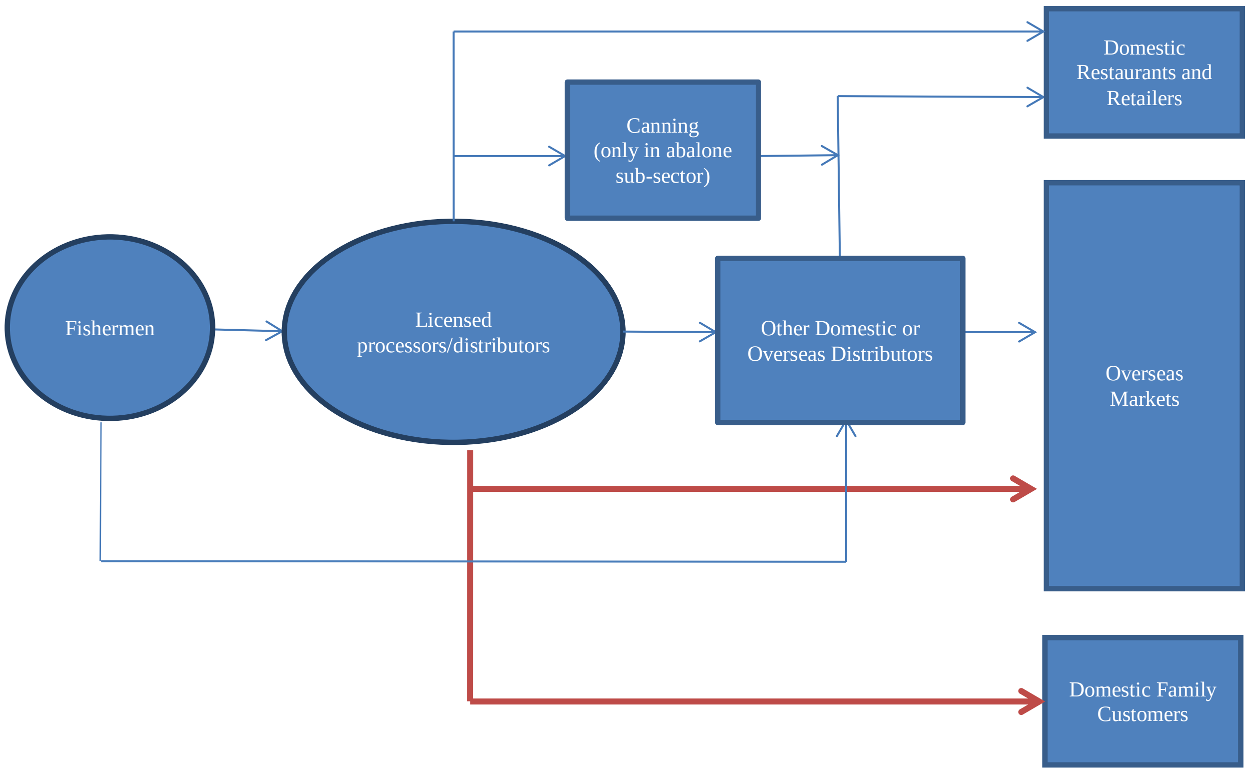

Figure 6-15: Refined Seafood Supply Chain in Tasmania

The interviewees are illustrated by the oval shapes and other supply chain partners are illustrated in rectangles. The red arrows indicate where ICT and Web 2.0 applications (apart from email) occur in the interactions between fishermen and seafood distributors, and their customers.

6.4.1.7 SUMMARY OF THE ICT AND WEB 2.0 USE IN SEAFOOD SUPPLY CHAIN

Overall, the survey and interview data indicated that rudimentary ICT and Web 2.0 systems were being used by the interviewees in managing the seafood supply chain activities, but that the situation is just starting to change. For example, an increasing number of ICT and Web 2.0 technologies are being used for marketing and sales, order processing, inventory management; and customer service. The information gained from the survey suggests the following:

ICT and especially Web 2.0 use focuses on marketing and customer relationship, but also shows its potential in other supply chain management activities such as inventory management and decision support.

The interviewees can be categorised into two groups, namely fishermen focusing on fishing, and fishermen whose businesses have operations extending into distribution. Their ICT use thus differs in several ways due to the two groups' different business goals and operations. ICT and especially Web 2.0 may be more useful for fishermen who have extended their operations into distribution. This kind of fishermen, who are effectively seafood distributors as well as fishermen, need to handle a larger number of suppliers, customers and transactions, which would be difficult without ICT assistance suggesting that 'number of customers' or 'customer type' may be a factor distinguishing primary producers' ICT applications - in this sector, at least.

The communication between fishermen and their distributors has been evolving gradually from predominantly phone calls to texting and email. This suggests that once the initial collaboration is established, personal interaction may not be as important in the subsequent transactions; and can be conducted effectively and efficiently by using ICT with less human interaction.

Lack of conventional Internet access or the high cost of satellite-based internet access is a challenge for fishermen wishing to use the ICT and Web 2.0 based systems from on-board their vessels. Government support for cheaper satellite access would have a significant impact on primary producers in this sector.

Return on investment is an important concern for uptake of ICT and Web 2.0 applications. Fishermen or seafood distributors will apply ICT and Web 2.0 to their SCM when the perceived benefits outweigh the cost and effort required for adoption. However the majority do not see sufficient benefits being realised for the effort and cost involved in applying ICT and Web 2.0 to their simple operations at this stage.

The challenges and problems encountered by the fishermen and seafood distributors in using ICT and Web 2.0-based systems for such things as electronic record keeping and ICT-enabled logistics suggest that ICT and Web 2.0 application in supply chain management may be affected by some ‘external factors’ such as industry readiness.

6.4.2 THE DAIRY SUPPLY CHAIN

There were seven interviewees from the dairy sub-sector. Indicative findings suggested that food processors (in particular raw milk processors) were the dairy farmers’ primary buyers and the dominant players in the dairy supply chain. This finding confirms the information provided by the dairy expert during the key informant interviews.

In addition to the mainstream dairy supply chain described by the key informants, a small number of primary producers also supplied to (or had established collaboration with) local processors to supply some niche markets. For example, D1 had many years of work experience in the service sector in an urban area before deciding to move to the land. She has applied her management skills to her agribusiness and operates her dairy farm rather differently than do the traditional dairy farmers who simply supply raw milk to large processors. D1’s dairy farm produces raw milk which is processed on site into a number of types of dairy product such as cheese and ice cream. These dairy products are mostly sold through the on-site café and a selection of the products is also sold to overseas customers via an online store.

D7 started out as a conventional dairy farmer supplying to large processors, but is now operating his dairy business in a rather different way as he had to adapt to the changes which have occurred in the dairy industry over the past few years (including droughts, floods and a dramatic lowering of raw milk prices following the aggressive entry of Australia’s two large supermarket chains into milk sales). D7 produces raw milk which is supplied to D3 for further processing before the dairy products are sold online. D3 operates a cheese factory in a remote area and uses an on-site café and an online store to sell the cheese products.

The dairy farmers processing and selling produce to individual customers are still, however, a minority in the dairy industry. D1 and D3 were invited to participate in the interview because of their popularity in the local region and their intensive use of ICT applications.

The ICT and Web 2.0 applications in the dairy supply chain are summarised in Table 6-3, where the typical Web 2.0 applications are highlighted.

Table 6-3: ICT and Web 2.0 Applications in the Dairy Supply Chain

Main Supply Chain Activities	ICT and Web 2.0 applications
Procurement	email
	Online shopping
Marketing and sales	email
	Online store
	Conventional websites
	YouTube
	Facebook
Order processing, inventory management and planning	**Online store**
	Dairyweb
Transport and distribution	email
	Star Track
Supplier and customer relationship management	email
	Twitter
	Facebook

More detailed information about ICT and Web 2.0 applications in the main supply chain activities are presented below.

6.4.2.1 Procurement

Farm suppliers and rural houses such as Roberts Limited (Roberts) and Elders Limited (Elders) are major suppliers for dairy farmers and dairy processors. All interviewees indicated that they generally purchased from these suppliers although a range of other suppliers also provide various equipment for dairy farmers and processors. Only limited ICT is used in this sub-sector.

6.4.2.2 Marketing and Sales

Although the majority of the dairy farmers surveyed were still supplying to large processors, a small number process or work with other small companies to process their raw milk and sell the resulting products beyond the main dairy supply chain via a range of channels such as retail and even online stores. This activity was not mentioned by the dairy experts in the key informant interviews, suggesting that the dairy supply chain is evolving and producing new and interesting concepts.

Compared with traditional farmers focusing on commodity production, D1 emphasised her marketing activities, saying:

> *"I think it is mainly because they (traditional dairy farmers) are focusing on commodity production first, and putting marketing second. I put marketing first and farming second. It is because you can grow anything you want; you can be the best farmer around but if you can't sell the crop you will go broke."*

D3 also believed ICT and, in particular, online sales are critical for small agribusinesses:

> *"Well, it came about maybe four years ago when we realised that the best model for the company was to deal direct with the consumer. So either over the counter, at the cellar door, or over the internet to our customers who had been here and then gone home again or who had found out about us where they lived because we do not sell into shops, or supermarkets. We only sell direct to consumers. And the only way to make that possible is ICT…. I would argue that, for small producers, the only way that they will survive in the future is through very strategic dealing direct to the consumers, which makes ICT critical."*

Both D1 and D3 have adopted a hybrid model referred to as a mix of traditional and online models (Vatanasakdakul et al. 2004) for their agribusinesses. Compared to D3, D1 had a more cautious perspective on online sales, believing these were a supplementary channel to sales made in the physical store. Even though she had sufficient ICT skills, she would not prioritise ICT at this stage as she felt she did not have enough time to manage the online store, did not have sufficient products to sell, and cannot achieve the best price from online sales. D1 said:

> *"It (online sales) is an add-on for the business, nothing more… because we only have a limited amount of product. We can't increase our product, so what we do is we look at where is the best effort for what we have got, our product. And selling it at our cellar door, we get full return, best return for us."*

The results of the survey questionnaire relating to the diary sub-sector are illustrated in Figure 6-16.

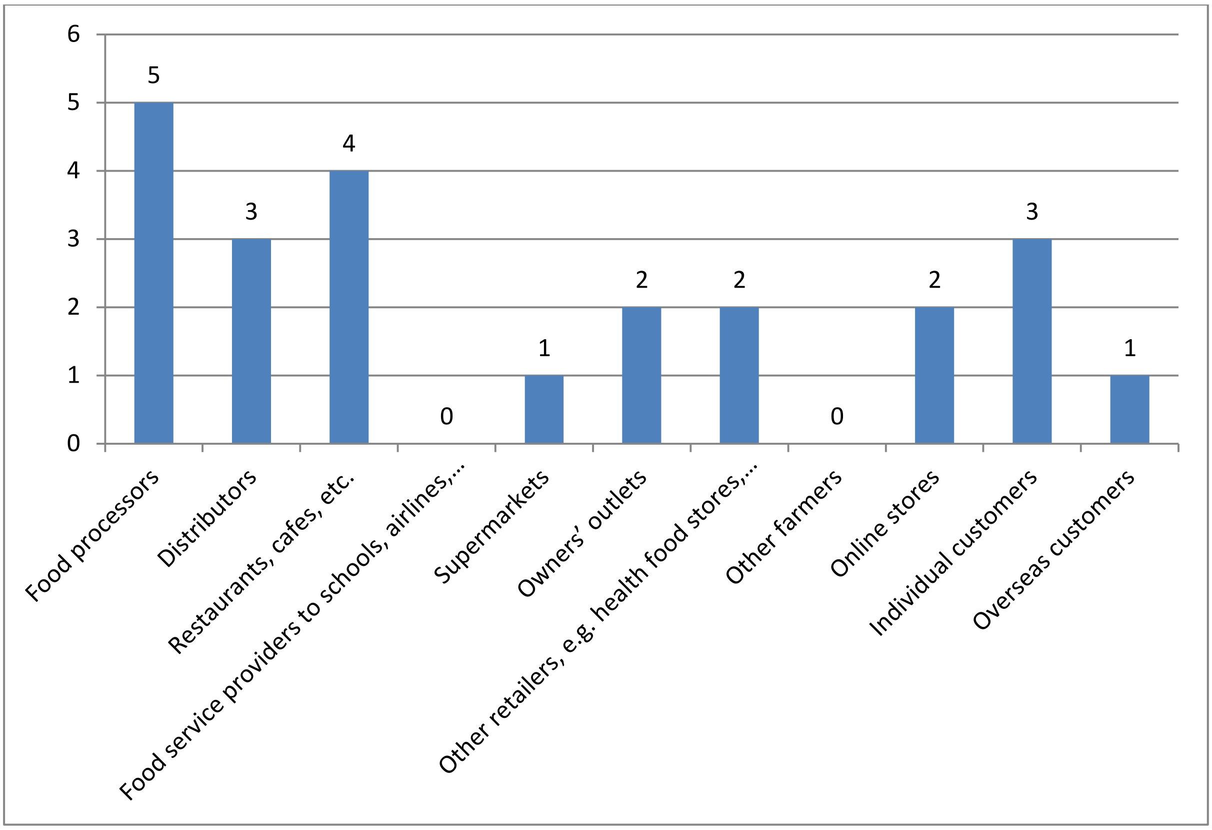

Figure 6-16: Customers of the Dairy Primary Producers

6.4.2.3 ORDER PROCESSING, INVENTORY MANAGEMENT AND PLANNING

A considerable amount of ICT has been used in the order processing, inventory management and planning components of the dairy supply chains. Lack of satisfactory technologies and devices that can be used while working on the farm were considered obstacles to widespread adoption.

Dairy farmers spend much of their time in the milking shed and there is a large amount of production data to be recorded. These data are generally recorded on a blackboard in the milking shed and transferred to the computer when the farmers go home. The absence of satisfactory ICT permitting them to record production data in the milking shed itself was seen as an inhibitor to the adoption of ICT.

There were significant differences between the primary producers supplying to the dominant processors or distributors and the primary producers outside the main dairy supply chains in terms of handling order processing, inventory management and planning activities.

For the dairy farmers supplying to large processors, product reports showing milk quality such as fat and protein are available online after testing. The online platform mentioned by the interviewees was Dairyweb (https://web1.dairyweb.com.au/): a web-based platform designed to connect milk processing corporations and dairy farmers. The platform supports collaboration with several dominant processors in the sub-sector, including Fonterra Australia and National Foods. A range of business information including milk quality and financial data can be viewed via this platform by suppliers to Fonterra and other major processing organisations.

However, the large processors do not provide any traceability information or any customer responses back to their suppliers, confirming the views of the dairy experts in the key informant interviews that most dairy farmers focused on producing raw milk, normally supplying to only one large customer; and did not have access to traceability information about their products.

Contrary to the information obtained in the Key Informant Interviews, a small number of dairy farmers (D1, D3 and D7) are involved in niche supply chains outside those dominated by the large processors. This group of primary producers had a good understanding of where their products went after leaving the farmgate; and had adequate communication with customers due to the short and simple nature of their supply chains. However, the order processing and inventory management activities between primary producers supplying to small dairy processors and their customers were limited to paper-based orders and telephone contacts because they did not consider it is worthwhile, in terms of cost and time involved, to set up such systems for their simple operations.

Myfoodlink is a unified e-commerce system designed for companies in food and grocery industries. This web-based platform enables processors to easily view and manage their sales record from an online store. One of the small dairy processors has applied this system to his online order processing and even into his business planning though, unfortunately, the information has not yet been shared with the primary producers who supply him with raw milk.

6.4.2.4 TRANSPORT AND DISTRIBUTION

Since transport is arranged by the large processors, most primary producers in the dairy sub-sector do not need to manage logistics after handing over their raw milk at their farmgate.

Their communications are largely dominated handled by phone contact and little ICT is needed for the arrangements.

For the agribusinesses selling to individual customers, a web-based platform (http://www.startrackexpress.com.au/online-tools/freightmaster/) appeared to be the most common method of managing logistic and transport its activities. While this company is not a specialist farm products transporter, it has filled a need for this small group of niche producers.

6.4.2.5 SUPPLIER AND CUSTOMER RELATIONSHIP MANAGEMENT

The dairy farmers supplying to the large processors did not have any contacts with (or feedback from) end customers, while the dairy farmers selling directly to their end customers used email and, more importantly, social media such as Facebook and Twitter to communicate with those end customers. This interaction improved the mutual understanding between the producers and the customers and enhanced the customer relationship, contributed to product development and facilitated sales.

6.4.2.6 THE REFINED DAIRY SUPPLY CHAIN DIAGRAM

Based on the findings gained from the dairy sub-sector, the supply chain diagram was refined and is presented in Figure 6-17.

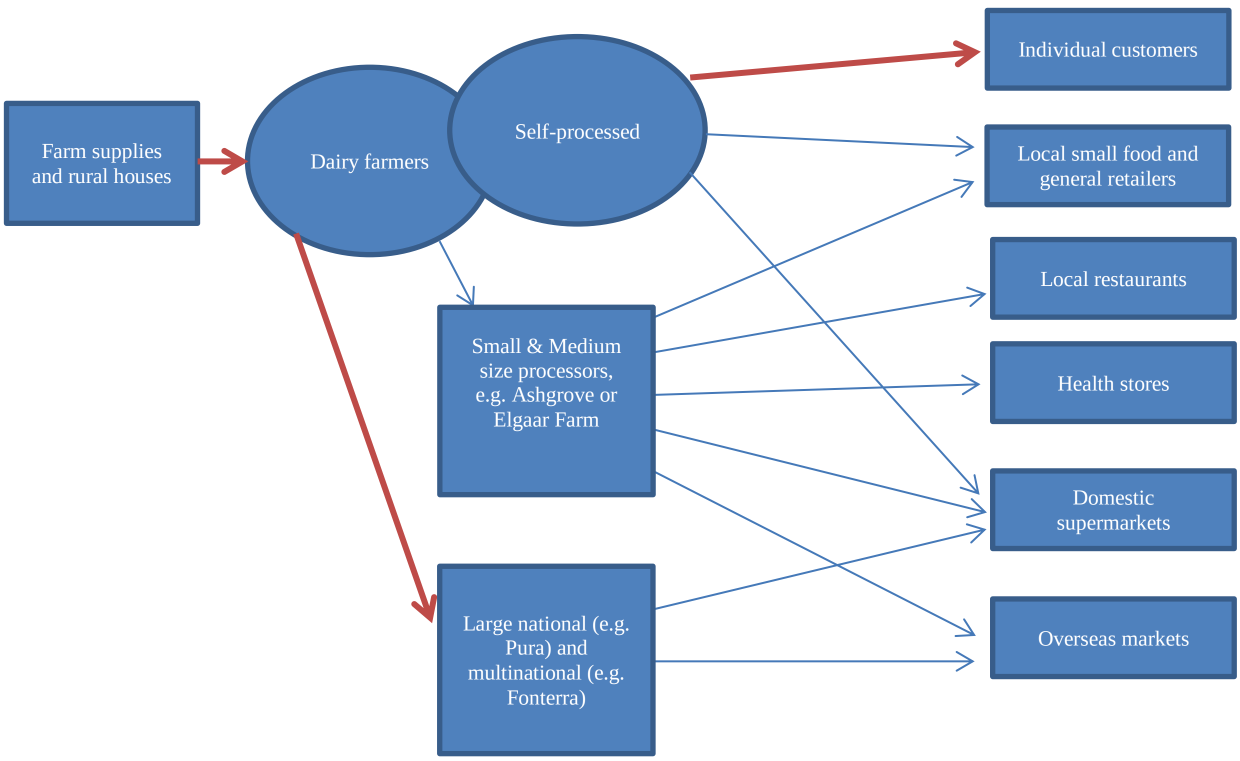

Figure 6-17: Refined Dairy Supply Chain in Tasmania

The interviewees are illustrated by oval shapes and other supply chain partners are displayed as rectangles. The red arrows indicate where there are ICT and Web 2.0 applications (apart from email) in the interactions with the interviewees.

6.4.2.7 Summary of ICT and Web 2.0 use in the Dairy Supply Chain

It was clear that only rudimentary and fragmentary ICT and Web 2.0 applications were used by the interviewees in managing the dairy supply chain activities, but the situation is starting to change. An emerging set of ICT and Web 2.0 technologies are being used in marketing and sales, order processing, logistics management and customer service. The survey results have enabled the drawing of a number of tentative conclusions.

In the dairy sub-sector, survey participants can be divided into two categories: the conventional group who supply to large dairy processors; and those supplying end customers outside the main dairy supply chain controlled by the large dairy processors such as Fonterra or National Foods. ICT and Web 2.0 use by these two groups of dairy farmers differs in several ways. The dairy farmers supplying to the large processors appear to be passive in terms of their ICT adoption, making use only of the software solutions required by their large customers. Since they focus on production, and do not need to manage their marketing and sales, or customer relationship they have little need for ICT. By contrast, the dairy businesses outside the main dairy supply chain who sell directly to a large number of end users have applied a range of ICT (and especially Web 2.0 technologies) to enhance their supply chain performance. Most of this use focuses on marketing and customer relationship management where Web 2.0 plays an important role.

These findings suggest that the ‘number of customers’ or ‘customer type’ of the primary producers in this sector may be a factor affecting their Web 2.0 application; and answers the question raised by Burke (2010) who suspected that customer type may be an influential factor in ICT adoption by small agribusinesses.

ICT and Web 2.0 use focuses on marketing and customer relationship management, but also offers their potential in other activities related to the supply chain management such as logistics management and decision support.

The findings indicate that return on investment is a major factor in any decision to adopt ICT and Web 2.0. The dairy farmers or dairy processors would apply ICT and Web 2.0 to their SCM only when the perceived benefits outweigh the effort required for adoption. Constrained by limited resources, these agribusinesses must allocate their time and effort in a cost effective way and will not prioritise ICT and Web 2.0 if they do not offer real benefits.

6.4.3 THE FRUIT SUPPLY CHAIN

Only two interviewees were from the fruit sub-sector. Constrained by the limited data, therefore, the findings relating to this sector may be less meaningful without the border contextual and qualitative information available on the other sub-sectors studied.

F1 is a man in his 60s with many years of experience in the fruit and vegetable industry. He ensures the viability of his fruit farm by providing fruit picking experience and farm tours to customers. He has applied a considerable amount of ICT and Web 2.0 technologies to his agribusiness. F2 is a man in his 30s who lives next to his orchard with his family. He sells his fruit to overseas customers through wholesale contracts; and to local customers by means of a roadside stall. F2 has applied little ICT and Web 2.0 in his supply chain activities, and did not show great interest in doing so.

In general, there is not a wide range of ICT applications for the fruit sub-sector. However, there is an emerging set of social technologies which have been applied to enhance activities in the fruit supply chain. The ICT and Web 2.0 applications in the fruit supply chain are summarised in Table 6-4, where the typical Web 2.0 applications are highlighted.

Table 6-4: ICT and Web 2.0 Applications in the Fruit Supply Chain

Main Supply Chain Activities	ICT and Web 2.0 applications
Procurement	email
Marketing and sales	email
	Conventional websites
	Facebook
Order processing, inventory management and planning	No ICT applications have been found in this domain
Transport and distribution	No ICT applications have been found in this domain
Supplier and customer relationship management	email
	iPhone app designed for enhancing fruit picking experience
	Facebook

The explicit information about ICT and Web 2.0 applications in the main supply chain activities are presented below.

6.4.3.1 PROCUREMENT

Both the fruit growers interviewed purchased baby trees and seeds from other seed growers or tree propagators, but F1 only explained this during his interview, rather than in the questionnaire. Like other farmers, farm supplies, agrichemical supplies and hardware stores were the primary suppliers for these agribusinesses.

Apart from basic email, neither fruit grower had used any ICT for procurement activities.

6.4.3.2 MARKETING AND SALES

Both fruit growers sold directly to customers, but in completely different ways, and these farmers had differing perspectives on how to apply ICT and Web 2.0 to their agribusinesses.

F1 offers farm tour and fruit picking experiences to customers. In addition, a contracted jam manufactory located not far from the farm has helped him turn a portion of his fruits into jam. The jam is sold in a variety of outlets, including his own on-site retail store and a number of other grocery stores.

F2 is involved in both retail and wholesale activities. A roadside fruit shed has been set up next to the farm where individuals can purchase his fresh produce directly; and he also sells his products to domestic supermarkets as well as to overseas markets, through large distributors. In the harvest season, F2 hires casual fruit pickers for assistance. Despite the high cost of labour, F2 had no interest in introducing fruit picking experience for customers - a view quite contrary to that held by F1, who makes much of his income from just such customer experience. F2 explains why he is against self-picking:

> *"Introducing fruit picking experience may use less labour, but we may have greater loss in field. Customers eat a lot and damage the trees."*

F1 has implemented extensive ICT, in particular, a social networking application for marketing. He realised the importance of ICT and especially the social technologies, but was also aware that an intensive focus on ICT-active customers might lead him to miss out on those customers still not using much ICT.

By contrast, F2 was happy with the way in which he has been managing his supply chain and was reluctant to adopt any ICT – largely because he felt that learning how to use the ICT applications would be an extra burden that he simply did not have the resources to manage.

6.4.3.3 ORDER PROCESSING, INVENTORY MANAGEMENT AND PLANNING

Neither of the fruit growers was using any ICT for order processing, inventory management or planning activities.

6.4.3.4 TRANSPORT AND DISTRIBUTION

Since the majority of their customers purchased their products on-site, these farmers' transport and distribution activities were simple. Phone is the method by which they communicate with their transport service providers. There was little ICT use in this domain.

6.4.3.5 SUPPLIER AND CUSTOMER RELATIONSHIP MANAGEMENT

F2 has used little ICT for relationship management, while F1 was very focused on his customer relationship management and realised the increasingly important role that ICT, especially Web 2.0, was playing in the area of CRM. A range of leading-edge ICT (such as smartphone application QR code) has been introduced to his agribusiness. This application was designed to provide hints on fruit varieties, the best stages at which to pick them; and provides a farm map to guide the picking.

6.4.3.6 THE REFINED FRUIT SUPPLY CHAIN DIAGRAM

Based on the findings gained from the fruit sub-sector, the supply chain diagram was refined and is presented in Figure 6-18. The interviewees are illustrated by means of oval shapes and other supply chain partners are displayed as rectangles. The red arrows indicate where there are ICT and Web 2.0 applications (apart from email) in the interactions with the interviewees.

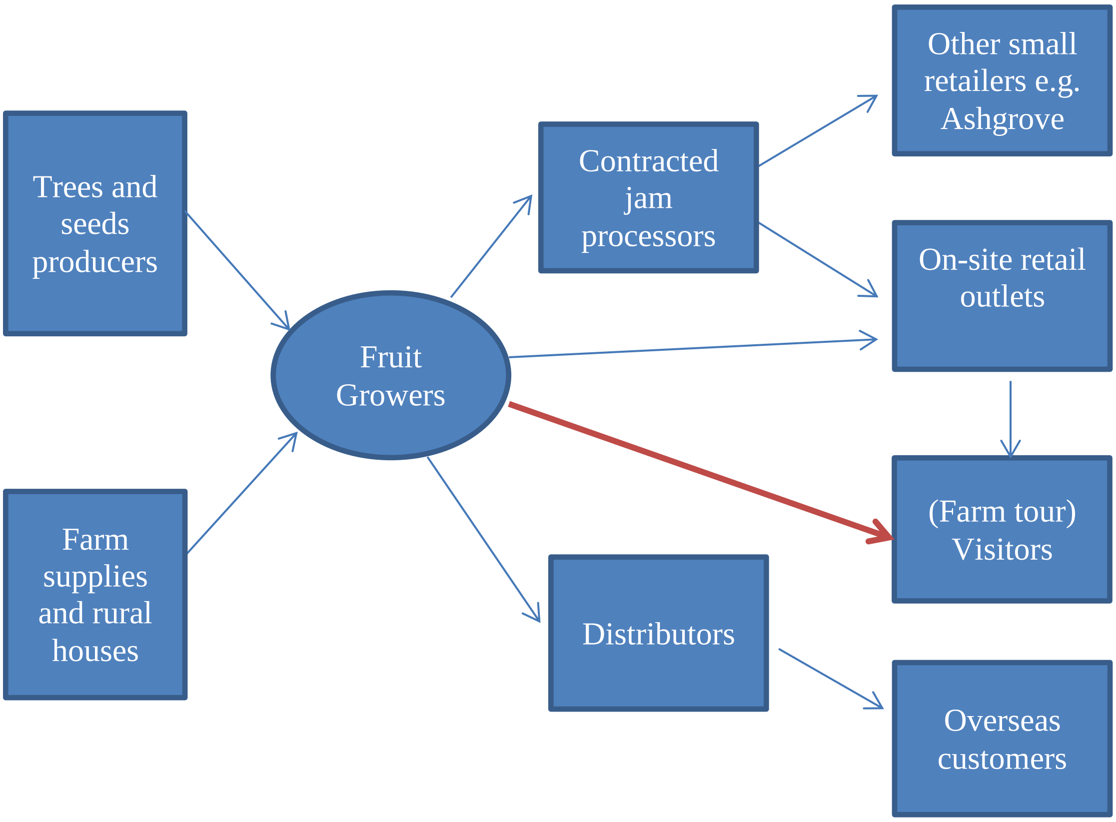

Figure 6-18: Refined Fruit Supply Chain in Tasmania

6.4.3.7 SUMMARY OF THE ICT AND WEB 2.0 USE IN THE FRUIT SUPPLY CHAIN

The survey results indicate limited ICT and Web 2.0 use by the primary producers in the fruit supply chain. The two interviewees from the fruit sub-sector provided an interesting contrast, operating their businesses in very different ways; and providing contrasting opinions and approaches to ICT adoption.

The 60-something F1 has taken a tourism approach towards running his fruit farm where customers can enjoy a fruit picking experience and purchase a range of processed fruit products such as fruit jam. The agribusiness has implemented a range of ICT - and especially Web 2.0- technologies - to enhance its marketing performance and customer relationship management. F1 has made a virtue of necessity, using his customers to pick his crop and focusing his attention on the social software applications which are so important in marketing directly to consumers.

The far younger F2 who is still in his 30s sells his produce to both overseas customers via wholesale contracts and retail customers who visit his roadside fruit stall. He has applied little ICT to his agribusiness, which is not surprising, as none of his activities depend on frequent communication or on luring customers to his business – his roadside stall effectively sells itself and his larger contracts are arranged by middlemen with whom he has infrequent communication.

This contrasting use of ICT in the same sub-sector suggests that ICT may well have much to offer older farmers, for whom the loss of physical strength may be more than offset by the ability Web 2.0 offers to connect with customers in other ways.

6.4.4 THE VEGETABLE SUPPLY CHAIN

There were six interviewees from the vegetable sub-sector. Five were traditional farmers who focused on commodity production and mainly supplied to large processors under contract. In addition to this group, VM2 was a hobby farmer who operated his agribusiness in a very different way since farm profit was not his primary income source. All six interviewees grew more than one product, usually vegetables and livestock.

There was limited ICT and Web 2.0 use in the vegetable supply chain, and this is summarised in Table 6-5.

Table 6-5: ICT and Web 2.0 Applications in the Vegetable Supply Chain

Main Supply Chain Activities	ICT and Web 2.0 applications
Procurement	email
	Online shopping
Marketing and sales	No ICT applications have been found in this domain
Order processing, inventory management and planning	**McCain AgPortal**
Transport and distribution	email
Supplier and customer relationship management	email

More detailed information about ICT and Web 2.0 applications in the main supply chain activities are presented below.

6.4.4.1 PROCUREMENT

As shown in Figure 6-19, conventional and local suppliers were popular sources for the purchase of supplies. In particular, vegetable growers usually purchased supplies from farm suppliers and rural houses, agrichemical suppliers, hardware stores, agricultural machinery and from other farmers. Three vegetable farmers have also purchased online.

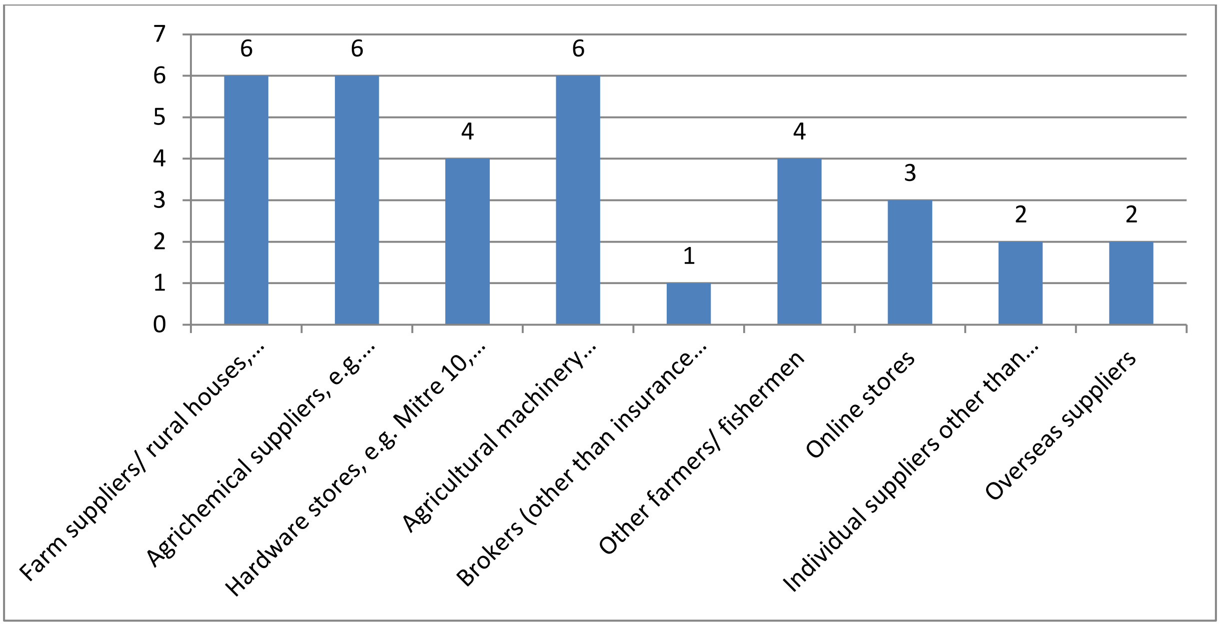

Figure 6-19: Vegetable Growers' Suppliers

In general the vegetable growers believed telephone was an efficient and suitable medium for purchasing supplies and their straightforward business activities did not require the use of ICT for procurement, which they believed would only make their life harder. VM3 said:

> *"That is easy, when I need some chemical supplies, I just ring the suppliers and they will bring me the stuff I want in a few hours. ICT is completely useless".*

6.4.4.2 MARKETING AND SALES

Most of the vegetable growers supplied their products to food processors and had applied little ICT to their marketing and sales activities. The result depicted in Figure 6-20 shows that 5 of the 6 interviewees supplied to food processors. The exception (VM2) was a retired teacher who did not earn his living from farm operation but considered it a potentially profit-making hobby. Without the survival drive most farmers face, VM2 did not have the same need to sell this produce at any price as the 'conventional' vegetable growers and thus had little need to sell to large processors.

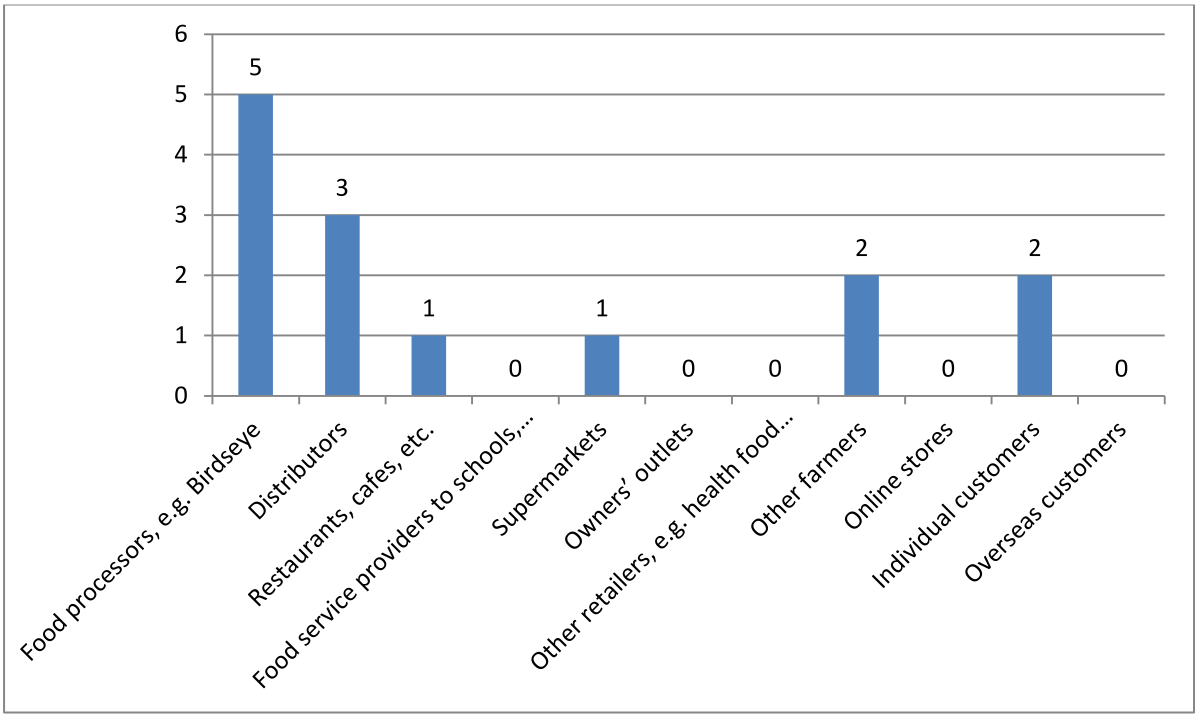

Figure 6-20: Vegetable Growers' Customers

The summary illustrated in Figure 6-20 shows just how important a role food processors play in this sector, where they are the dominant buyers for the majority of the vegetable growers interviewed. This is consistent with the information gained from the key informant interviews. VM5 said:

> *"Our customers are processors. There are not many growers selling to individual customers. We can't sell such a large volume of produce ourselves. If we sell it to individuals it costs a lot of time to do it."*

The nature of the vegetable sub-sector helps to explain this finding; vegetables require a long period of time (and considerable effort) to plan, plant, grow and harvest, making it essential to have contracts securing their bulk sale at an acceptable price in fluctuating markets. VM3 explained that:

> *"Potatoes need two years planning in advance; we need to have a contract to determine what to grow in the next two years… excepting for distributors and processors who will come and buy bulk produce"*

6.4.4.3 ORDER PROCESSING, INVENTORY MANAGEMENT AND PLANNING

Most of the interviewees were focused on commodity production and adopted traditional techniques for order processing, inventory management and planning, based on pen and paper. Planting and harvest are scheduled by the large processors to whom the primary producers are contracted. The farmers' business planning is largely based on their own experience accumulated over decades of vegetable growing.

The existence of long-term contracts, regular purchasers and an annual growing cycle has meant that vegetable growers do not see any obvious benefit from ICT use. The only Web 2.0 use identified in the survey was an online portal, McCain AgPortal, provided by McCain Foods (Aust) Pty Ltd to enable its suppliers to check the test report of products sales. VM3 was critical of the limited ICT applications available for in-field use:

> *"Farmers are very busy and we need to work on the farm for the whole day. I need to drive my tractor for most of the time. We have no time to use a computer…there was no ICT that can be used when I was driving my tractor."*

It is by no means uncommon for farmers to produce more than a single agricultural product, some because they hope to avoid market gluts and slumps, some because their land does not support a single crop or animal (perhaps because some parts of the land are richer than others); and some because they wish to avoid the dangers of monoculture such as pests, fungi or weather related events. Many of these vegetable growers participating in the survey also bred livestock. Although this supports the view that diversification and planning are important for both farmers and, more importantly, entire farming communities this diversification did not contribute to enhance ICT use in this domain.

6.4.4.4 TRANSPORT AND DISTRIBUTION

The vegetable processors had strict regulations with their contracted farmers with harvest and transport of the products being managed by large local vegetable processors. VM5 said:

> *"The company provides all the transport. The company also arranges the harvest."*

A snapshot taken at an interviewee's vegetable farm is shown in Figure 6-21. The red trucks are multifunction vehicles for harvest and transportation.

Figure 6-21: Multiple Function Vehicles for Vegetable Harvest and Transport

The harvest and transport schedules were arranged by phone. Apart from email, little ICT has been used in these activities.

6.4.4.5 SUPPLIER AND CUSTOMER RELATIONSHIP MANAGEMENT

Since the vegetable growers predominantly supply to large processors, they do not have any direct contact with or feedback from the end customers; and no traceability information is shared with end customers. Thus the vegetable growers (who in most cases are families who have been vegetable growers for several generations) saw no immediate benefit in ICT applications and have not used any ICT to manage their supplier or customer relationships.

6.4.4.6 THE REFINED VEGETABLE SUPPLY CHAIN DIAGRAM

Based on the findings gained from the vegetable sub-sector, the supply chain diagram was refined and is presented in Figure 6-22. The interviewees are as ovals and other supply chain partners are displayed as rectangles. The red arrows indicate where there are ICT and Web 2.0 applications (apart from email) in the interactions with the interviewees.

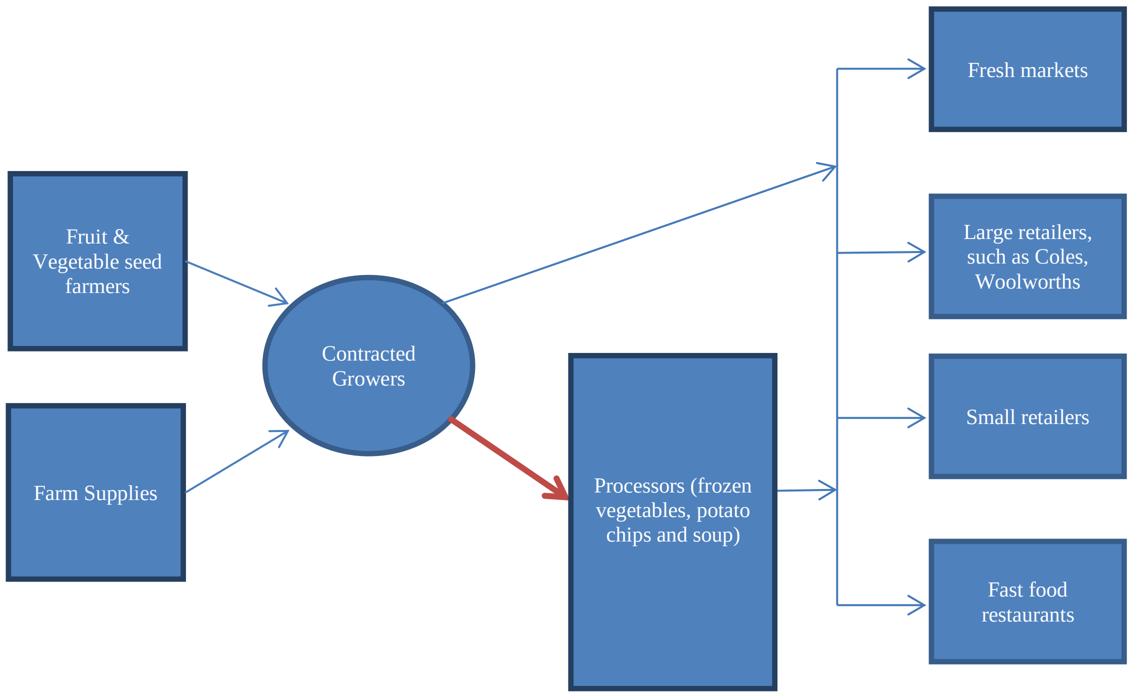

Figure 6-22: Refined Vegetable Supply Chain in Tasmania

6.4.4.7 SUMMARY OF ICT AND WEB 2.0 USED BY PRIMARY PRODUCERS IN VEGETABLE SUPPLY CHAIN

The survey results indicate only the most limited ICT and Web 2.0 use by the primary producers in the vegetable supply chain, who mostly supply the bulk of their produce to large processors under contract.

This suggests that vegetables are not an immediately suitable product type for online sales – except in the case of niche markets such as direct growers' markets and alternative agri-food suppliers such as health stores, etc. The most likely reasons for the poor fit between vegetables and direct marketing are that: firstly, the unit value of these products is very low and suited to be commodity sales, which makes bulk products of this kind less suited to online purchasing; secondly, the perishability of these products makes them unsuited for long distance delivery, unless they have been at least semi-processed (e.g. by snap freezing). It is thus less surprising that so many vegetable farmers grow to order, in bulk, in response to long-term contracts with large food processors. This finding further indicates that external factors such as 'character of the agri-food products' and the 'sub-sector' are important in determining ICT application in the supply chain.

However the finding should be viewed with caution because the interviewees participating in the survey were self-selected. Cold calling and farmers' referrals were two approaches employed to recruit the interviewees. Several interviewees who had already established Facebook pages for their vegetable businesses refused to participate in the survey, and it was therefore not possible to investigate their cases. Research undertaken (Burke 2010; Takeno et al. 2008) in the alternative agri-food supply chains suggests that, just as with those dairy farmers who found Web 2.0 an extremely useful method of connecting with their end-consumers, it may well be the case that those farmers who are growing vegetables for niche markets are also actively using ICT and Web 2.0 for their own marketing and CRM activities. This issue will be discussed further under Future Works in Chapter 9.

6.4.5 The Livestock Supply Chain

There were ten interviewees from the livestock sub-sector. Six of these were engaged in both livestock breeding and vegetable growing, and the remaining four bred livestock as well as engaging in a variety of other activities such as dairy farming and poppy growing.

The ICT and Web 2.0 applications in the livestock supply chain are summarised in Table 6-6, where the typical Web 2.0 applications are highlighted.

Table 6-6: ICT and Web 2.0 Applications in the Livestock Supply Chain

Main Supply Chain Activities	ICT and Web 2.0 applications
Procurement	email
Marketing and sales	**AuctionsPlus**
	Gumtree.com
Order processing, inventory management and planning	**National Livestock Identification System (NLIS)**
	email
Transport and distribution	email
Supplier and customer relationship management	email

Detailed information about ICT and Web 2.0 applications relating to in the main supply chain activities are presented below.

6.4.5.1 Procurement

Conventional and local suppliers were the preferred option by livestock breeders for purchasing supplies. Farm suppliers and rural houses, agrichemical suppliers, hardware stores, agricultural machinery companies and other farmers were the most common channels from which they obtained supplies. Livestock farmers predominantly used phone to order their supplies or purchased the supplies in person. Apart from email, little ICT was used for procurement.

6.4.5.2 MARKETING AND SALES

Processors, distributors and other farmers are dominant customers, while agents are the most important transaction facilitators. Although e-marketplaces (in particular, AuctionsPlus) are available, few livestock farmers have made use of this innovation, although the classified advertisement website Gumtree (http://www.gumtree.com.au/) was used by one livestock farmer for online trading.

Livestock farmers are unlikely to sell their produce directly to end customers because the stock has to be processed before sale. The processing facilities are too complicated and the processing procedures involve considerable food safety regulation and hygiene requirements which are too difficult for livestock farmers to manage, with the result that most livestock are sold to processors and distributors. M1 said:

> *"Processors are larger scale and have more value added processing. Individual butchers aren't always able to do this."*

One interim stage is, however, very common: livestock are often sold to other farmers for fattening before they are sold either in saleyards or to processors – which explains why three of the four interviewees chose "other farmers" as their customers. Such sales are popular with farmers who have either insufficient land, or insufficient water to support their entire herd or flock during the 6-24 months needed for fattening. M3 explained:

> *"Lamb and beef cattle supply chains are very similar, farmers grow lamb and then sent them to other farmers to fatten then sell them to butchers … I can't do the fattening, as we don't have irrigated grass to fatten the lambs."*

Livestock agents play an important facilitation role in the trades and transactions involved in livestock sales. M3 identified the importance of agents in the livestock supply chain, saying:

> *"They* (the agents) *help me to identify customers and suppliers… Security is the reason why farmers rely on agents, because sometimes butchers go bankrupt after*

> *taking your livestock … The agent knows the price. The agent organises the transport and ships the stock to Victoria … The reasons why we need the middleman, because he sets the price and makes buyers and sellers happy otherwise we just can't come to an agreement."*

AuctionsPlus (http://www.auctionsplus.com.au/) is an e-marketplace for livestock auction and trading online. Prior to the existing Internet presence created in 1998, access to AuctionsPlus was via an Intranet. The e-marketplace is currently operated by AuctionsPlus Pty Limited. Only two interviewees mentioned this e-marketplace during the interviews and the survey results suggested that while many livestock farmers have used AuctionsPlus for trading occasionally, the application is far from being a standard in the sub-sector. Three reasons for this were given by the livestock farmers: initially, the images and videos displayed on the website did not provide adequate information for buyers to assess the quality of the livestock when each of them was unique; secondly, managing the online trading was time-consuming and the livestock farmers were too busy to take on an additional chore of this kind; and thirdly, livestock trading in Australia still relies on personal contacts, especially on agents.

It is interesting to compare these findings with the study undertaken by Driedonks et al. (2005) who examined the adoption of AuctionsPlus from social and economic perspectives. Compared with Driedonks et al. (2005)'s findings that agents' resistance to new technology was a major obstacle for the adoption of ICT, the present study has instead found the lack of critical services in the existing ICT applications, such as the livestock assessment and trade management the livestock agents provide, appeared to be the most significant inhibitors to adoption. Another important different with the Driedonks et al. study was a failure to identify loss of social capital as an important inhibitor, as the livestock farmers in this project showed their willingness to take any changes to their agribusinesses which might maximise their profits. It appears that either the marketplace has changed significantly between 2005 and 2012 (when the majority of the interviews and the survey were undertaken for the present project), or that the differing perspectives of the researchers make the findings difficult to compare (or both).

One practical use of ICT was a classified advertisement website – Gumtree (http://www.gumtree.com.au/) – which was being used for marketing and sales purposes by one of the interviewees in the livestock sector. VM2 used Gumtree to buy and sell his lambs.

There are two possible explanations for this atypical behaviour (both of which may well be involved). In the first place, VM2 is a hobby farmer and growing lambs is not his primary income source – it is, rather, simply an activity he enjoys. In addition, VM2 believed that lamb is a low-value product compared to cattle, with individual animals selling for a value of only around $100 each, so that the level of risk in using online sales was acceptable.

6.4.5.3 ORDER PROCESSING, INVENTORY MANAGEMENT AND PLANNING

Although it is required that livestock farmers register their animals with the National Livestock Identification System (NLIS) online, the majority of the interviewees' order processing and inventory management systems were still paper-based. The breeding, growing, fattening and selling of livestock requires careful planning and involves a considerable amount of calculation, but most livestock farmers did this on the basis of experience. For example, primary producers need to mate their animals at a particular time to ensure their offspring are born at the right time of year to enable them to reach the right size for a particular market date. This involves a great deal of pasture management to ensure specific feed nutrient quality and conditions at specific times of the year. Despite the importance of these activities, little use was made of ICT for breeding, whether in terms of deciding which animals were ready to be 'joined' or in terms of calculating weights and conditions. It may well be that the farmers interviewed were sufficiently experienced that they could see no benefit in adding ICT support to activities they had been doing successfully for decades – a tentative conclusion which needs further research before any confidence can be placed in it.

6.4.5.4 TRANSPORT AND DISTRIBUTION

In selling livestock, whether sheep or cattle, it was normal for the buyers to arrange transport, and communication predominantly took place via phone. Little ICT was used to arrange transport or facilitation.

6.4.5.5 SUPPLIER AND CUSTOMER RELATIONSHIP MANAGEMENT

Livestock farmers are accustomed to a situation where there is no direct contact between themselves and their end customer and customer service was therefore not a focus for them. As a result, they could not see any immediate benefit in applying ICT in their relatively simple practice of supplier and customer relationship management.

6.4.5.6 THE REFINED LIVESTOCK SUPPLY CHAIN DIAGRAM

Based on the findings gained from the livestock sub-sector, the supply chain diagram was refined and is presented in Figure 6-23. The interviewees are illustrated by means of oval shapes and other supply chain partners are displayed as rectangles. The red arrows indicate where there are ICT and Web 2.0 applications (apart from email) in the interactions with the interviewees.

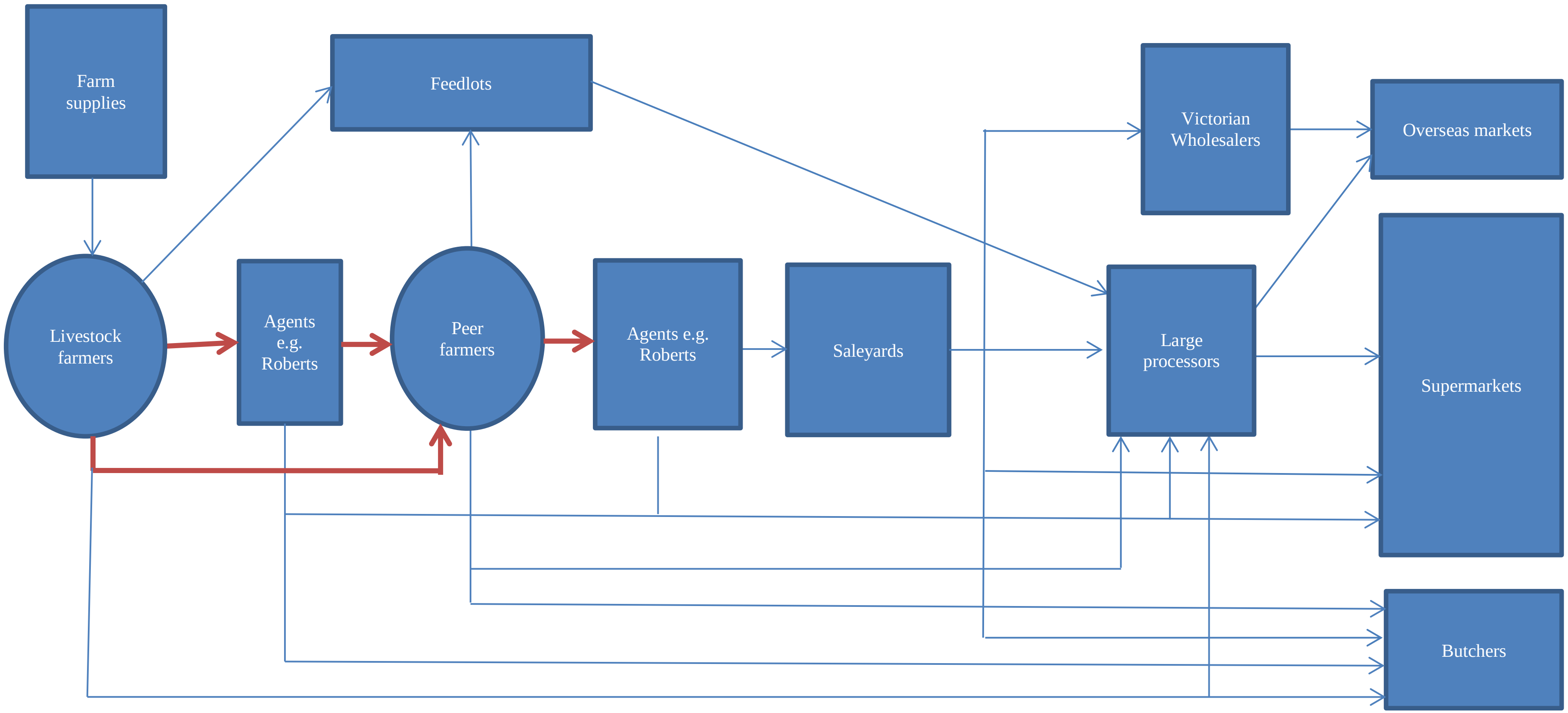

Figure 6-23: Refined Livestock Supply Chain in Tasmania

6.4.5.7 SUMMARY OF ICT AND WEB 2.0 USED BY PRIMARY PRODUCERS IN LIVESTOCK SUPPLY CHAIN

The survey results indicate only limited ICT and Web 2.0 use by the livestock farmers in the supply chain; and these limited uses are in marketing activities and traceability. The information gained from the survey suggests the following tentative conclusions.

The importance of the NLIS, introduced by the Australian government, suggests that external factors such as government enforcement may play a significant role in ICT and Web 2.0 application uptake by this sub-sector. The findings also suggest that agricultural products such as meat are less suitable for trading online due to a combination of complex processing needs and hygiene requirements. It further indicates that some external factors such as 'character of the products' and 'sub-sector' may well be important determinants for ICT and Web 2.0 applications.

The survey results suggest that livestock farmers are not necessarily averse to using ICT and may be happy to change their way of doing business to maximise profits.

6.4.6 NBN ISSUES

When this survey journey was begun the NBN rollout regions in Tasmania were extremely limited and the interviewees were generally lacking in NBN-related information. One of the most important expectations of NBN is the video conferencing capability, but it was not clear to interviewees whether this facility would really be available – or indeed, when it might be available in their region.

When the acronym 'NBN' was used during the interview very few interviewees showed a clear understanding of the term. After briefly introducing the NBN project, many were still confused about the difference between existing Internet connections and the NBN-enabled Internet service. The inaccurate answers in their questionnaires reflected their lack of NBN knowledge. According to M2:

> *"Many farmers have not experienced the fast internet access that is available in the metro area and cannot make a comparison and are therefore quite happy with the existing Internet access."*

Most interviewees could not think of any benefits likely to emerge from the adoption of the NBN. After several benefits had been suggested by the interviewer, however, high resolution video conferencing was the most popular new feature. The interviewees suffering from poor telecommunications facilities had high expectations of the NBN. D3 said:

> *"We desperately want to improve the speed and reliability of our internet service. And then just grow. Growing with what we already do…… (The Video conference enabled by NBN is) definitely (useful) because we have a partner in the business who lives in Melbourne. That would be very useful."*

Their concern about the advent of the NBN is its possible cost. One of the NBN users, S5, expressed his mixed feelings about the fact that the high-speed broadband may increase the cost of his Internet use in the long run:

> *"We have NBN not long ago. The optic fibre is cool, and we can see the obvious difference. I worry about the cost in the long run which comes from our taxes."*

6.5 CONCLUSION

This Section has discussed the profiles of the survey and interview participants; and the ICT and Web 2.0 applications employed by Tasmanian agri-food SMEs in the seafood, dairy, fruit, vegetable and livestock supply chains.

Based on the 28 survey interviews and 13 follow-up interviews, the results suggest the following tentative conclusions:

The farming population in Tasmania is aging – with the average age of participants being in their mid-50s. The female members of the family businesses usually manage in-house work while the farming work is handled by the male farmers. Primary producers can be categorised as traditional farmers, sea change farmers and hobby farmers in terms of their career backgrounds and business goals.

In order to make full use of the land, as well as to eliminate the risk of market fluctuation from monoculture, many primary producers produce more than one product. This majority of the primary producers interviewed, however, are still focusing on commodity production, although a small number have started to sell to their end customers directly using online channels (and especially a Web 2.0 approach).

While Internet use was prevalent, few primary producers maintain a website for their agribusinesses. The NBN adoption rate was low at the time of data gathering, as the rollout area for this service was still limited; and most primary producers had little understanding of what the NBN was or what possible benefits it might bring.

Phone and face-to-face were the two most popular communication methods. Although many of the interviewees have used some form of ICT to manage their supply chain activities, this use was still rudimentary. The ICT systems being used were gradually evolving to web-based systems, with the result that many of the ICT applications in use can be considered Web 2.0 applications, as ‘web as a platform’ is an important principle of Web 2.0. It was also encouraging to see that an increasing number of Web 2.0 technologies, especially those used for personal communication and entertainment, have been applied to enhance SCM.

The ICT and Web 2.0 applications differ in a number of significant ways in various supply chains for a range of reasons, including the widely differing characteristics of the products, the level of readiness of the sub-sector; and variations in supply chain structures.

The next Chapter identifies the factors which encourage primary producers to apply ICT and Web 2.0 to their SCM, or which are obstacles inhibiting such application.

Chapter 7

Survey Analysis for Model Modification

7.1 INTRODUCTION

Chapter 6 described the first part of the survey analysis, presenting an overview of the survey results and a description of each agri-food supply chain in terms of its ICT and Web 2.0 use. This Chapter analyses the effect/s which the empirical data gathered in the survey had on the determinants and moderators of the RuWebTAM model and their interactions, illustrating the revised model which emerged from this phase of the research project.

Both quantitative and qualitative data analysis methods have been employed to gain a comprehensive understanding of the reasons for ICT adoption and to refine the research model. The answers gathered from the survey questionnaire provide a quantitative base for the analysis, making use of cross tabulations to gain further insight into the answers provided and, more importantly, to identify and explain the reasons behind other factors which might be considered moderators of the research model – such as gender, age, number of customers and technology experience. In addition these quantitative results were enriched, supported and strengthened by the qualitative information gathered from the semi-structured interviews.

The structure of this Chapter is as follows: the next Section analyses the quantitative data from the survey and uncovers the motives and obstacles associated with interviewees' ICT adoption. A re-introduction of the original research model is presented in Section 7.3; and this is followed by Section 7.4 'Determinants of the Research Model' and Section 7.5 'Moderators and Their Relationship with Determinants', where the model modifications are addressed along its two axes. The final section of the Chapter, Section 7.6, concludes the Chapter.

7.2 MOTIVES AND OBSTACLES FOR APPLYING ICT TO SCM

Three questions were included in the questionnaire to gauge interviewees' opinion about ICT application in their SCM in a quantitative (systematic) way:

Q.13 How important were the following motives for adopting ICT in your Supply Chain Management?

Q.14 How important were the following obstacles in preventing you from using Information Communication Technology in your Supply Chain Management (SCM)?

Q.16 If you are using Web 2.0 for your Supply Chain Management, which of the following factors influenced you?

Although Q.13 and Q.14 gauged the motives for and obstacles to the interviewees' ability to apply ICT to their SCM generally, the results have also been extended and applied to modify the research model in terms of Web 2.0 technologies. This approach can be justified because, as Section 6.3.6 has already suggested, the majority of the ICT solutions used by the agri-food SMEs studied to manage their supply chain activities can be considered Web 2.0 applications. This means that a Web 2.0-enabled supply chain is effectively interchangeable with an ICT-enabled supply chain. Respondents' views on ICT acceptance in general can therefore be taken as a reasonable indication of Web 2.0 acceptance. Secondly, it is easier for primary producers to answer questions about their general ICT use, of which they have an adequate understanding, than to provide answers about abstract and unfamiliar Web 2.0 applications.

7.2.1 MOTIVES FOR APPLYING ICT TO SCM

The answers to Q.13 (depicted in Figure 7-1) show that 8 out of 9 motives listed in the questionnaire were considered important motives for applying ICT to SCM by over 50% of the interviewees. These results indicate that many interviewees believed ICT had real potential to enhance their SCM.

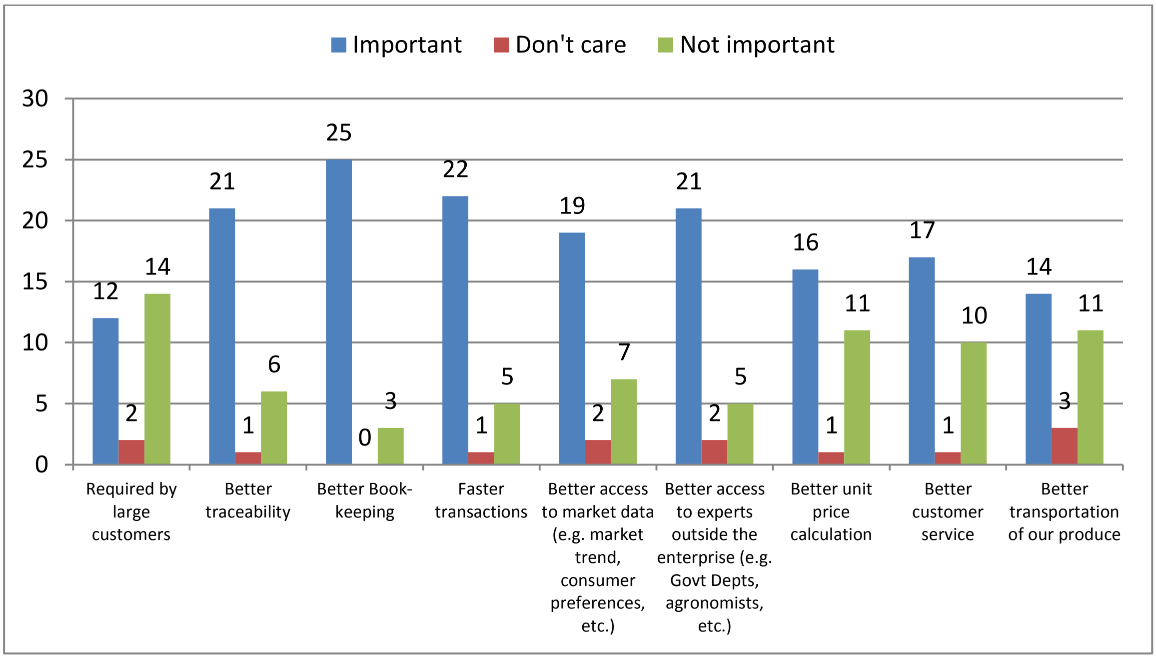

Figure 7-1: Motives for applying ICT to SCM

'Better book keeping', broadly referred to as 'better record keeping' in the survey interview, was chosen by most respondents (89.3%, n=25) as an important motive, followed by 'faster transactions' (78.6%, n=22), 'better traceability' (75.0%, n=21), 'better access to experts outside the enterprise' (75.0%, n=21), 'better access to market data' (67.9%, n=19), 'better customer service' (60.7%, n=17), 'better unit price calculation' (57.1%, n=16) and 'better transportation of our produce' (50.0%, n=14), while 'required by large customers' (42.9%, n=12) were the motives chosen by the least respondents.

Contrary to expectations, 'required by large customers' was not considered an important motive by the majority of the primary producers – though this result only means that the requirements of large customers were not applicable to the agribusinesses themselves, rather than not being important overall. With 12 supporters (42.9%), this was the only factor fewer than 50% of respondents believed was a motive for ICT adoption. This result must be interpreted with caution, however, as the majority of the interviewees said they would use ICT if their large customers asked them to do so – but they had not had any large customers for a long time. Several interviewees expanded on their answer to this question during their interview. For example, S3 said:

> *"If the customers or processors ask me to use it I have to use it. But at the moment no one asks me to use it so I don't (use it)."*

S4 said:

> *"I do not have large customers so it is not important."*

M1 said:

> *"None of customers require it at the moment, it is just not applicable."*

Those participants who did have large customers (predominantly the dairy farmers), however, saw 'required by large customer' as a potentially important motive for ICT adoption. D4, a dairy farmer, said:

> *"Well I suppose if my milk company wanted me to, then I suppose I would. So, yes (I would). Like, if they said: "OK, we are going to go to Web 2.0, then you will be able to get all the stuff", then yes, that would make it easier. For access, then I probably would."*

During the interviews, 'better book-keeping' (and better record keeping) had the highest percentage (89.3%) of interviewees who considered it their most significant motive for applying ICT to SCM. This highlights the limitations of the record keeping and communication approaches currently being used by most small primary producers, such as face-to-face or phone. Although email is commonly used by all interviewees, this result also shows up its weakness as a record-keeping solution, since email does not provide standard records for users to sort and compare.

The importance of keeping records of all communications is highlighted by S1's comment. This farmer was very happy with Skype and, especially, with its ability to keep records of conversations:

> *"By using Skype (voice chat and messaging functions), we can keep the conversation record (by using its messaging function), which is important. It is free and the quality is quite good."*

These findings can be compared to research undertaken by Rolfe et al. (2003) who investigated the factors influencing Australian farmers to adopt Internet. The ratings given by these authors for perceived advantage from Internet use are summarised in Table 7-1.

Table 7-1: Perceived Advantages in Internet use (Rolfe et al. 2003)

	Very low	Low	Medium	High	Very high
Better information	16	9	22	14	7
Less paperwork	19	8	20	11	8
Improved customer service	36	9	13	4	1
Faster supply of goods	27	8	8	8	0
Better inventory control	33	10	9	4	1
Reduced costs	27	12	16	5	0
Service differentiation	34	12	8	3	0
Competitive advantage	36	3	10	8	1

For the sake of comparability, the data gathered in 2003 have been re-grouped: Rolfe et al's 'very low' and 'low' categories have been combined to provide a more effective comparison with the 'not important' category in the present research project; the medium category has been retained and compared to the "do not care" category in the present research; and Rolfe et al's 'high' and 'very high' categories have been combined to compare with the 'important' category in the present research.

Table 7-2: Comparing Motive of ICT adoption between 2003 and 2012

Rolfe t al. (2003) Findings		This Research	
Motivation	Importance	Motivation	Importance
Better information	30.9% (21 of 68)	Better access to market data	67.9% (19 of 28)
Improved customer service	7.9% (5 of 63)	Better customer service	60.7% (17 of 28)
Faster supply of goods	15.7% (8 of 51)	Better transportation of our produce	50% (14 of 28)

The comparison shown in Table 7-2 suggests that, overall, the perceived advantages of ICT applications have grown significantly over the past decade. All the comparable factors have been considered as important by a higher percentage of interviewees in the present research project. For example, in contrast to 30.9% (21 out of 68) interviewees who considered 'better information' a perceived advantage of ICT adoption, 'better access to market data' was considered important by 67.9% (19 out of 28) interviewees in this research project. Where only 7.9% (5 out of 63) of interviewees considered 'improved customer service' an important advantage in 2003, the figure for 'better customer service' has jumped to 60.7% (17 out of 28) in this research. In 2003, interviewees were less concerned about faster supply of goods with only 15.7% (8 out of 51) interviewees viewing it as a perceived advantage, whereas 50% (14 out of 28) interviewees considered 'better transportation of our produce' an important advantage in this research.

This encouraging result indicates a growing acceptance and, more importantly, a growing understanding, of the importance of ICT use in the agri-food industry.

7.2.2 OBSTACLES FOR APPLYING ICT TO SCM

The interviewees' opinions concerning perceived obstacles to applying ICT to SCM are depicted in Figure 7-2. Of the 12 obstacles listed in the questionnaire, five were chosen by over 50% of the interviewees as being important obstacles: 'poor telecommunication infrastructure' (75.0%, n=21); 'reliability of the SCM software' (75%, n=21); 'not accessible in field' (i.e. available ICT devices lack mobility) (71.4%, n=20); 'flexibility of the SCM software' (67.9%, n=19); and 'concern about security' (53.6%, n=15). All five of these factors are related to infrastructure and technical issues. By contrast, three management-related factors ('lack of manager's support' (17.9%, n=5) which refers to lack of support from management; 'not willing to change our existing way of doing business' (10.7%, n=3); and 'negative comment from our community' (3.6%, n=1)) were not considered important obstacles to adoption by the majority of the participants.

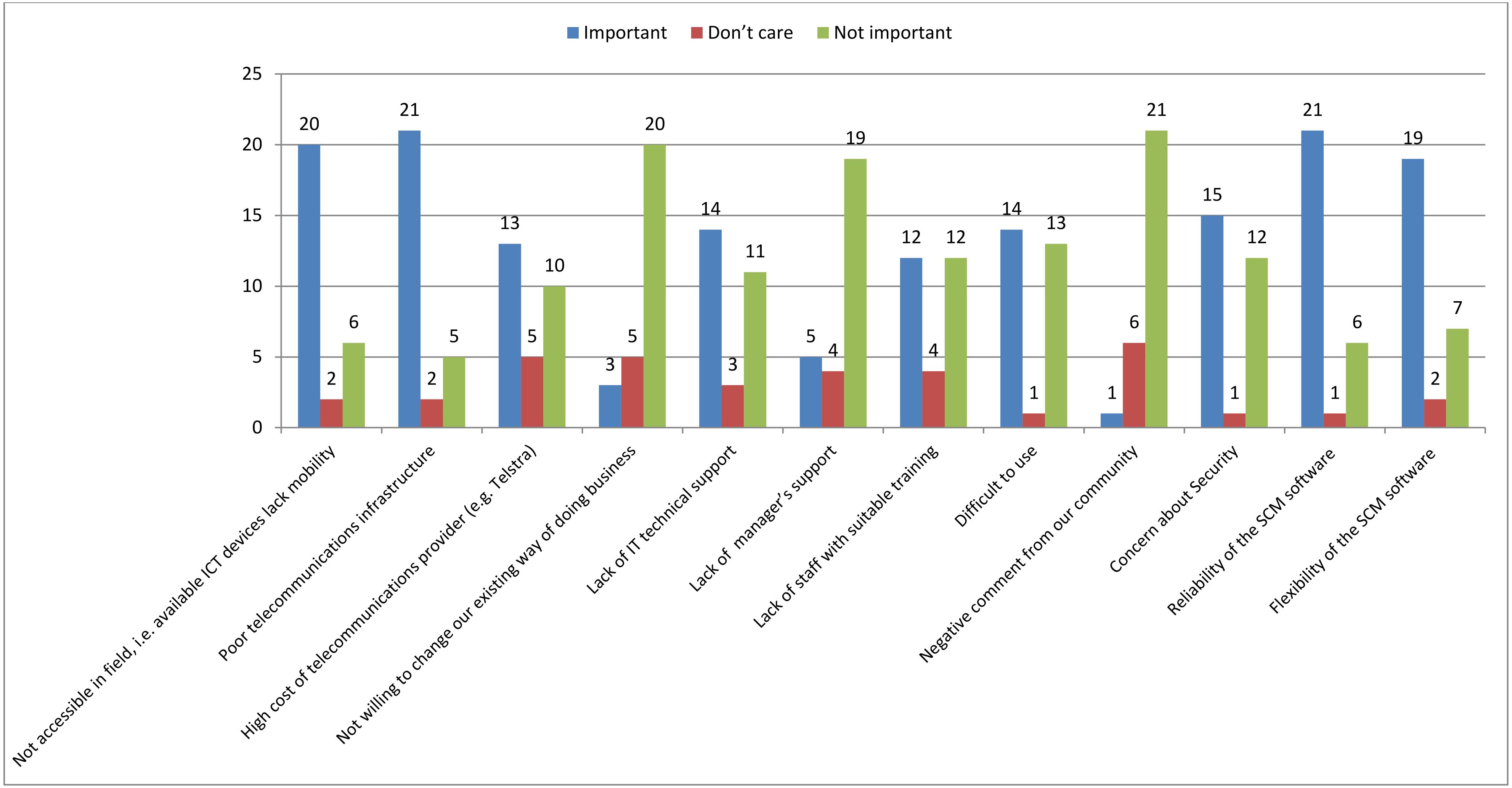

Figure 7-2: Obstacles for applying ICT to SCM

Consistent with the literature (Brush & McIntosh 2010; Lu & Swatman 2009; Warren 2004) and key informant interviews, 'poor telecommunications infrastructure' was seen as an important obstacle for ICT adoption by the greatest number of interviewees (75%, n=21). S2 explained the reason for not using much ICT:

> *"And the problem we had is actually the access, when we go to the west coast we don't have any Internet, no phone. We have satellite phone and it is very expensive, $2 a minute. No data transfer. I have a laptop and when I cross the river there is no mobile internet coverage."*

Inadequate – and occasionally non-existent – telecommunication infrastructure in rural and remote parts of Australia is one of the major selling points for the NBN. It remains to be seen, however, whether the rollout will be widespread enough to resolve the problems of primary producers.

'Not accessible in field' (71.4%, n=20) was the third most important obstacle to ICT adoption in terms of number of interviewees, supporting the finding obtained in the Key Informant Interview that it is difficult for primary producers to record data in-field and then to move these data to a computer at home after work. The primary producers generally believed that the usefulness of ICT and adoption of ICT will be enhanced if the SCM applications and satisfactory devices were to become accessible in-field. S3 assured us that:

> *"The SCM software would be very useful if it can be used on the boat."*

Fewer than half the interviewees considered 'high cost of telecommunications provider' (46.4%, n=13) to be an important inhibitor. The interviewees claimed that they were happy to pay for good telecommunications service as long as it provided sufficient value for money. An interesting finding was that the three oldest interviewees did not consider the high cost of telecommunications an obstacle in applying ICT to SCM, which may suggest that older primary producers are more willing to pay for an ICT service which permits them to overcome their SCM challenges. Alternatively, it is possible that older primary producers are more financially secure, having survived for so many years in the business; or that.in family operations, it is often the older (and less physically capable) members who value new technology which enables them to continue working effectively even after the peak of their physical strength is gone – younger male participants, in particular, were inclined to value heavy equipment more than telecommunications. However, given the very small sample, these reasons need further investigation as there may well be other factors involved, such as the possibility that older interviewees might not have wanted to be viewed as ICT-laggers who were not willing to invest in ICT applications.

Existing SCM software that was unsuited to or not compatible with existing supply chain practice was considered an obstacle to the application of ICT. For example, in speaking about AuctionsPlus – the e-marketplace designed for livestock farmers to conduct online trading and auctions – M1said:

> *"Why not use AuctionsPlus? Because it is just a platform and does not have any marketing functions."*

M3 said:

> *"Why don't I use AuctionsPlus? I still need an assessor (to assess the livestock)."*

Only a small number of interviewees (10.7%, n=3) identified unwillingness to change their existing ways of doing business as an important obstacles to ICT adoption. This suggests that most of the interviewees were willing to adapt their business operation in response to external changes.

'Lack of a manager's support' (17.9%, n=5) was not considered an important obstacle simply because most of the participants are family businesses and thus did not have any managers to consider.

Apart from the above obstacles listed in the questionnaire, 'lack of natural human interaction' was identified as an important obstacle by VM3 in that:

> *"I fly to Sydney or Melbourne to meet with the blokes. I can see their reactions when talking to them face-to-face; I can also keep nagging them."*

The overall results suggest that technological factors such as 'poor telecommunication infrastructure' (75%, n=21) and 'Not accessible in field, i.e. available ICT devices lack mobility' (71.4%, n=20) which refers to unsuitable devices outweighed management and social factors such as 'unwillingness to change our existing ways of doing business' (10.7%, n=3) and 'negative comment from our community' (3.6%, n=1) are the main obstacles to the agri-food SMEs ability to apply ICT to SCM.

These results can be compared to the findings of Gelb and Voet (2009) who summarised the inhibitors preventing farmers from using ICT over the past decade. The data, focusing on results from European countries, are shown in Table 7-3 and were gathered from the EFITA conferences (European Federation for Information Technology in Agriculture, Food and the Environment) which are held every 2 years and were provided by conference attendees. The numbers of responses were 58 in 1999, 65 in 2001, 52 in 2003, 60 in 2005 and 56 in 2007.

Table 7-3: Comparing Inhibitors Preventing Primary Producers from Adopting ICT (Gelb & Voet 2009)

	Bonn 1999 (n=58) (%)	Mont. 2001 (n=65) (%)	Debrecen 2003 (n=52) (%)	Villa Real 2005 (n=60) (%)	Glasgow 2007 (n=56) (%)	This research 2012 (n=28) (%)
Inability of farmers to use ICT ("difficult to use" in this research)	29.3	3.0	34.6	45.0	12.5	50.0
Unperceived economic or other benefits	27.6	27.6	21.2	23.3	21.4	N/A
Lack of technological Infrastructure ("poor telecommunication infrastructure" in this research)	18.9	6.0	23.1	35.0	28.6	75.0
Cost of technology ("high cost of telecommunication providers" in this research)	17.6	32.3	25.0	25.0	23.2	46.4
Not enough time to spend on technology	12.1	16.9	19.2	10.2	23.2	N/A
Do not understand the value of ICT	8.6	16.9	26.9	30.0	17.9	N/A
Lack of training (lack of staff with suitable training)	8.6	20.0	19.2	16.7	17.9	42.9

A comparison between the data gathered in this research and the data gained from the EFITA conference participants indicates that, overall, the inhibitors identified by primary producers were more serious in the recent study than the conference participants believed. In particular, 50% of the SMEs in this research have claimed that 'difficult to use' was an important inhibitor, which was a considerably greater percentage than the responses from any of those conferences. Similar results can also be found in the perception of other comparable inhibitors such as 'lack of technological infrastructure', 'cost of technology' and 'lack of training'. The biggest difference in results regarding a perceived inhibitor can be found in 'lack of technological infrastructure' (which was referred to as 'poor telecommunication infrastructure in this study'). This inhibitor was considered as important by 75% interviewees in this study, which had the biggest gap (75% in 2012, and 6% in 2001) identified. The figures gathered in this research were at least twice as large as the figures gathered in any EFITA conference since 1999.

The possible explanations for these results are two-fold. At the outset, the conference participants may have underestimated the difficulties encountered by the primary producers in practice. Next, Australians, and the Tasmanian primary producers in particular, may face more challenges than their European peers, especially in the field of telecommunication infrastructure – European farmers are both considerably less remote than their Australian counterparts and are the beneficiaries of very much more sophisticated telecommunications.

7.2.3 FACTORS INFLUENCING THE APPLICATION OF WEB 2.0 TO SCM

The survey outcomes depicted in Figure 7-3 show that all respondents expect the application of Web 2.0 to SCM will be easy to use (100.0%, n=28). Most also expected it would be easy (for them) to interact with other supply chain members (96.4%, n=27), 'accessible by mobile phone' (92.9%, n=26), 'free system available' (89.3%, n=25), 'reduces IT investment' (89.3%, n=25) and 'allows integration of many sources' (82.1%, n=23). These were all perceived as important motives by the majority of the interviewees.

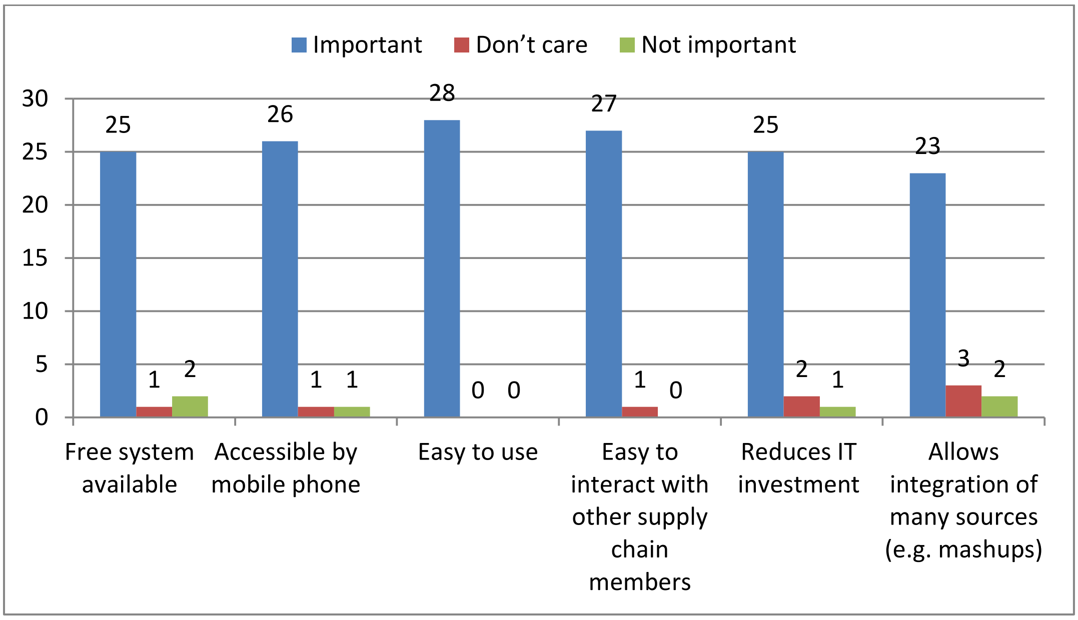

Figure 7-3: Factors Influencing Application of Web 2.0 to SCM

This result suggests that although the agri-food SMEs had little experience in applying Web 2.0 to SCM, they had high expectations of Web 2.0 technologies being able to overcome the weaknesses of the existing ICT applications in SCM.

7.3 THE ORIGINAL RESEARCH MODEL

This is a review of the original research model – RuWebTAM – which was presented in its original form in Chapter 3. This review will be followed by a discussion of the components of the revised model and a justification for the changes. The original model is made up of five determinants ('time savings', 'cost savings', 'effort expectancy', 'communication quality' and 'social influence') and four moderators (gender, age, 'domain experience' and 'technology experience') as shown in Figure 7-4.

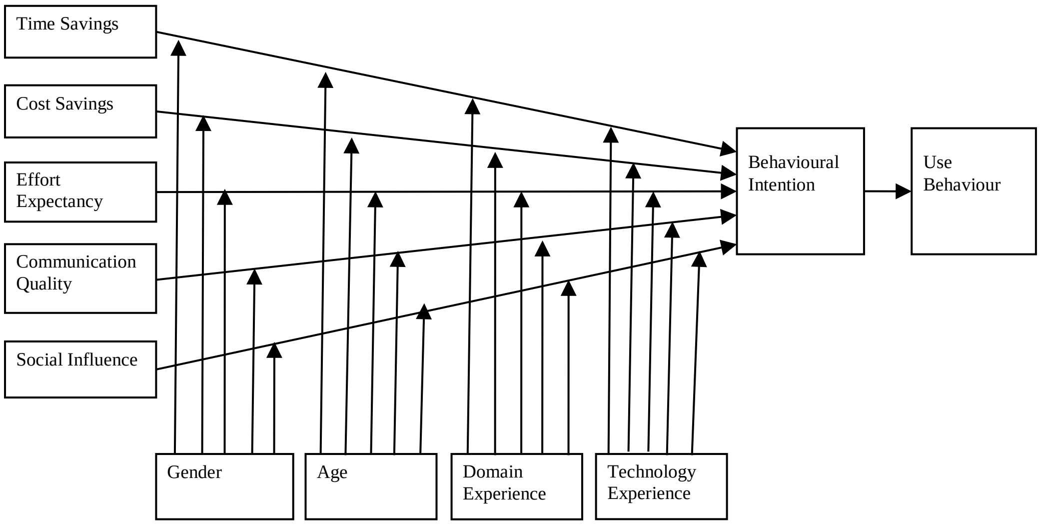

Figure 7-4: RuWebTAM

These determinants and moderators were tested by means of the survey and interviews and the modifications suggested by the empirical data are discussed and presented in the next Section.

7.4 DETERMINANTS OF THE RESEARCH MODEL

The five determinants of the original model were tested empirically and the quantitative and qualitative data obtained from the surveys and interviews has been used as the basis for a number of changes to these determinants. Specifically, the following sources have provided the impetus for change to the determinants:

- The responses to Q.13, presented in section '7.2.1 Motives for Applying ICT to SCM', which analysed the importance of the nine motives primary producers identified for adopting ICT in their SCM;
- The responses to Q.14, presented in section '7.2.2 Obstacles for Applying ICT ', which analysed the importance of 12 obstacles identified as preventing primary producers from using ICT in their SCM;
- The responses to Q.16, presented in section '7.2.3 Factors Influencing the Application of Web 2.0 to SCM', which identified the factors influencing primary producers to apply Web 2.0 to their SCM;
- The responses to Q.17 which identified external factors influencing the use of Web 2.0 application in primary producers' SCM;

- The results presented in section '6.4 ICT and Web 2.0 use in Differing Supply Chains';
- The information gathered from the conversations with the interviewees.

As a result of the empirical data gathering it was realised that the original research model did not reflect the findings gathered from the survey. The model was therefore modified and it is presented in Figure 7-5.

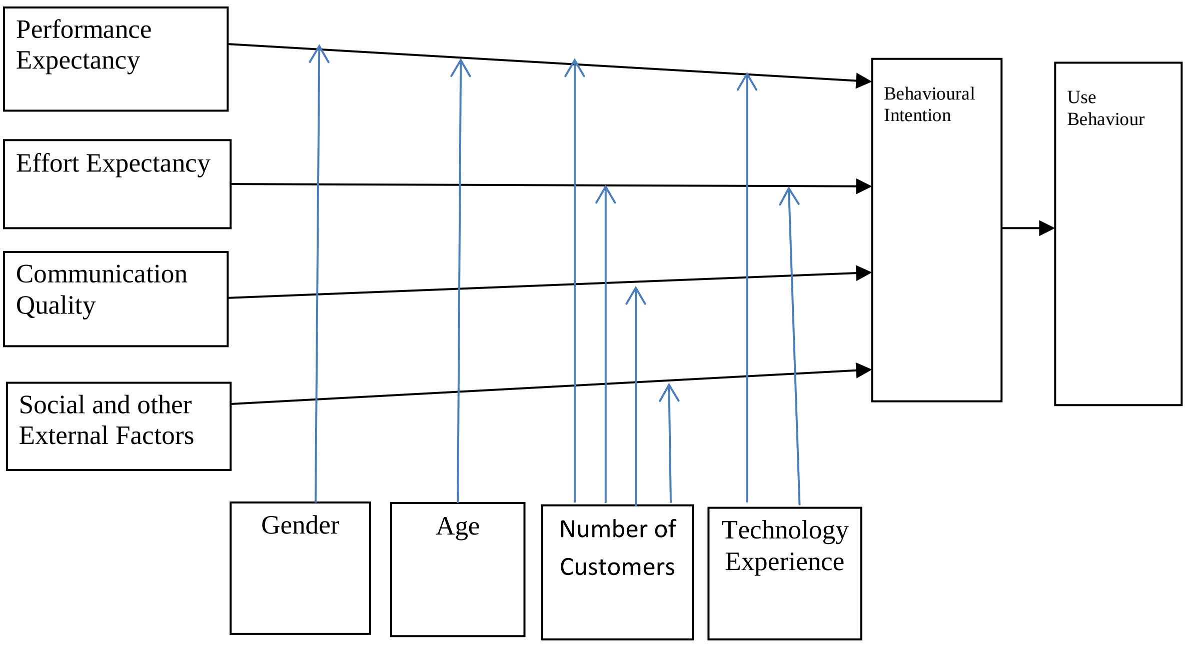

Figure 7-5: RuWebTAM 2

The following modifications have been made to the determinants:

- 'Cost savings' and 'time savings' have been combined into a more inclusive determinant – 'performance expectancy'
- 'Effort expectancy', 'communication quality' and 'social factors' have been retained in the model, but
- 'Communications quality' now also includes 'telecommunications infrastructure'; and
- 'Social influence' now incorporates 'external factors' to form a more inclusive determinant: 'Social and other external factors'.

The revisions to the determinants were identified by the answers to a range of relevant factors listed in the questionnaire. The relationship between the determinants and their related motives and obstacles are summarised in Table 7-4.

Table 7-4: Determinants and Their Constructs in the Survey Questionnaire

Determinants in RuWebTAM version 2	Related Motives or Obstacles	% of interviewees believing it is important (number of interviewees)
Performance Expectancy	Better traceability	75.0 (n=21)
	Better book (and record) keeping	89.2 (n=25)
	Faster transaction	78.6 (n=22)
	Better access to market data	67.9 (n=19)
	Better access to experts outside the enterprises	75.0 (n=21)
	Better unit price calculation	57.1 (n=16)
	Better customer service	60.7 (n=17)
	Better transportation of our produce	50.0 (n=14)
	Web 2.0 systems reduces IT investment	89.3 (n=25)
	Web 2.0 systems allow integration of many resources	82.1 (n=23)
Effort Expectancy	Not willing to change our existing way of doing business	10.7 (n=3)
	Lack of IT technical support	50.0 (n=14)
	Lack of staff with suitable training	42.9 (n=12)
	Difficult to use	50.0 (n=14)
	Concern about security	53.6 (n=15)
	Reliability of SCM software	75.0 (n=21)
	Flexibility of SCM software	67.9 (n=19)
	Free Web 2.0 systems available	89.3 (n=25)
	Web 2.0 systems ease of use	100 (n=28)

Communication Quality	Poor telecommunication infrastructure	75.0 (n=21)
	High cost of telecommunications providers	46.4 (n=13)
	Not accessible in field, i.e. available ICT devices lack mobility	71.4 (n=20)
	Web 2.0 systems accessible by mobile phone	92.9 (n=26)
	Web 2.0 systems enable easy interaction with other supply chain members	96.4 (n=27)
Social and other external factors	Required by large customers	42.9 (n=12)
	Lack of managers' support	17.9 (n=5)
	Negative comment from community	3.6 (n=1)

Only one change has been made to the moderators: gender, age and 'technology experience' have been retained, while 'domain experience' has been removed as it did not accurately reflect the study's findings. A new moderator, 'number of customers', has been identified and incorporated into the model in its place.

The justifications for these modifications are now discussed.

7.4.1 COMBINING COST SAVINGS AND TIME SAVINGS INTO PERFORMANCE EXPECTANCY

The 'time savings' and 'cost savings' determinants in the original research model, have been combined to form a single new determinant – 'performance expectancy' for two reasons: firstly, it often proved difficult for the interviewees to distinguish whether their motivation for using ICT was time savings or cost savings – or a little of both; and, secondly, many motives that were considered important factors for applying Web 2.0 to SCM were actually related to their ability to enhance SCM performance.

In Section 7.2 (Motives and obstacles for applying ICT to SCM) eight of the nine motives identified in relation to the application of ICT to SCM were identified as important factors by more than 50% of the interviewees, with only a single exception ('Required by large customer' (42.9%, n=12)). These motives, in order of popularity, were: 'better book (and record) keeping' (89.3%, n=25), 'faster transactions' (78.6%, n=22), 'better traceability' (75.0%, n=21), 'better access to experts outside the enterprises' (75.0%, n=21), 'better access to market data' (67.9%, n=19), 'better customer service' (60.7%, n=17), 'better unit price calculation' (57.1%, n=16) and 'better transportation of our produce' (50.0%, n=14).

All of these eight motives are actually related to expected performance enhancement (Venkatesh et al. 2003) of participants' SCM.

In addition, when considering factors influencing the application of Web 2.0 to SCM, two related factors which also relate to SCM enhancement – (Web 2.0 systems) 'reduces IT investment' (89.3%, n=25), and (Web 2.0 systems) 'allows integration of many sources' (82.1%, n=23) – were selected by the majority of the interviewees.

The importance of 'performance expectancy' in determining adoption was supported by many interviewees in a variety of sub-sectors. The perception that little perceived performance enhancement can be achieved by applying ICT to their businesses (and in particular, Web 2.0) was the main obstacle preventing participants from using technology. S2 said:

> *"As you know my business is rather simple. I produce one product and sell it to one customer. The use of ICT would be of little value to me."*

It was somewhat surprising to discover one interviewee (VM3) believed none of these motives would be sufficient for him to adopt ICT. VM3 held a negative and pessimistic perception about ICT adoption and did not believe ICT could help his business at all. He said:

> *"Smartphones and apps are everywhere but they are just toys. And we have no money to set up IT … What IT can help in my business? Maybe it allows me to give the bank manager a call to let them know I am bankrupt, so I left the key at the door and have gone … ICT can only help create jobs for people like you* (the investigator)*"*

VM3's pessimistic opinion about the possible usefulness of ICT applications suggests that performance expectancy may be a more general term with a wide range of performance expectancy needs to be enhanced. There may be priorities in improving those performances, whereas improving supply chain performance may not be the top priority for all users – for some of whom ICT and Web 2.0 application may not be a major concern.

It is also worth noting from the words used by VM3 that this interviewee clearly had major financial worries (indicated by his suggestion that the one useful purpose of ICT would be to let his bank manager know he had gone bankrupt and was walking off his property). There is a danger in drawing too many conclusions from a single outlying view which may, in fact, reflect the individual participant's personal situation rather than a general principle.

These responses led to 'cost savings' and 'time savings' being removed from the model and replaced with 'performance expectancy' as a new determinant in the revised research model. Since the survey data was not sufficient for an investigation of the coverage of 'performance expectancy' this variable will be examined at the data validation stage (reported in Chapter 8).

7.4.2 EFFORT EXPECTANCY

Effort expectancy proved to be an important determinant and has been retained in the research model. As discussed in Section 7.2.2 ('Obstacles for applying ICT to SCM') many obstacles related to 'effort expectancy' were considered important factors by the majority of the 28 interviewees. These obstacles include 'reliability of the SCM software' (75%, n=21), 'flexibility of the SCM software' (67.9%, n=19), 'concern about security' (53.6%, n=15), 'lack of IT technical support' (50.0%, n=14), 'difficult to use' (50.0%, n=14) and 'lack of staff with suitable training' (42.9%, n=12).

The obstacle 'not willing to change our existing way of doing business' (10.7%, n=3), which was not considered an important factor by the majority of the interviewees should, however, be viewed with some caution in view of the sample size. Nonetheless, the survey results do indicate that primary producers appear to be happy to make some changes to adapt to the external environment.

In terms of those factors influencing the application of Web 2.0 to SCM, 'free systems available' was selected by 89.3% (n=25) interviewees; and all interviewees (100.0%, n=28) considered (Web 2.0 systems is) 'easy to use' as an important motive.

'Effort expectancy' is a crucial factor determining Web 2.0 adoption, as few of the primary producers surveyed were expert in the use of ICT and have little time to spend on using technology. S3 commented:

> *"The easier the software is the more people will use it. If you get software that requires a university degree to use it, it would stop many people using it."*

Based on the above justification 'effort expectancy' is retained in the revised research model.

7.4.3 COMMUNICATION QUALITY

'Communication quality' has been retained as a determinant, but its definition refers not only to mutual communication via software, but also includes the telecommunications infrastructure used by the farmers. This has a direct impact on communication quality in the rural areas where most primary producers are based and this has led to a revision of the concept covered by this variable. The identification of this determinant is supported by the following evidence.

As discussed in '6.4.1.7 Summary of the ICT and Web 2.0 use in Seafood Supply Chain' poor telecommunications was considered an important inhibitor for ICT application, while the strength of Web 2.0 which enables mutual communication was regarded as a motive for applying Web 2.0 to SCM.

As shown in 'Table 7-4: Determinants and Their Constructs in the Survey Questionnaire' the factors related to communications quality and, in particular, telecommunications infrastructure, were considered important obstacles to applying ICT to their SCM. These factors include; 'poor telecommunication infrastructure' (75.0%, n=21), 'not accessible in field', i.e. available ICT devices lack mobility (71.4%, n=20), and 'high cost of telecommunication providers' (46.4%, n=13). The importance of these issues was highlighted in the interviews. For example, S2 said:

> *"Reliability in my industry is related to accessibility of internet. Mobile connectivity is unreliable and simply not available in a lot of areas and the cost of satellite infrastructure is very expensive. Perhaps the introduction of satellite NBN would solve the issue."*

In relation to the factors influencing the application of Web 2.0 in SCM, almost all respondents expected the application of Web 2.0 in SCM would make it 'easy for them to interact with other supply chain members' (96.4%, n=27) and 'accessible by mobile phone' (92.9%, n=26). These results support the importance of communications quality. VM4 said:

> *"The supply chains have no transparency and the information does not come back … On Facebook you can go to your customers all the time, in contrast, websites can only wait for customers to come over … It is important to have the ability to have two way communications."*

Communications quality is therefore a determinant retained in the revised research model, with a slightly revised definition.

7.4.4 SOCIAL AND OTHER EXTERNAL FACTORS

The social influence determinant in the original model remains in the revised research model, but now incorporates "other external factors" to form a more inclusive factor entitled 'social and other external factors'. The modification is supported by the following indicative findings.

As discussed in '6.4.1.7 Summary of the ICT and Web 2.0 use in Seafood Supply Chain', '6.4.4.7 Summary of ICT and Web 2.0 used by Primary Producers in Vegetable Supply Chain' and '6.4.5.7 Summary of ICT and Web 2.0 used by Primary Producers in Livestock Supply Chain' a range of external factors may have an effect on the application of ICT and Web 2.0 to SCM. These external factors include 'character of the products', 'industry readiness' and the widely varying operations which occur from one farming sector to another.

Three factors are related to 'social and other external factors' in the survey questionnaire and these, interpreted using contextual information, support the 'social and other external factors' as a determinant. These three factors are: 'required by large customers' (42.9%, n=12), 'lack of manager's support' (17.9%, n=5) and 'negative comment from our community' (3.6%, n=1). Although these three factors shown in the questionnaire results (see 'Table 7-4: Determinants and Their Constructs in the Survey Questionnaire') have not been considered important by the majority of interviewees, the results need to be interpreted with contextual information if they are to be truly meaningful.

As discussed in section '7.2.1 Motives for Applying ICT to SCM', 'required by large customers' was actually an important factor but was not applicable to the large proportion of interviewees who have not had any large customers over the past few years. Similarly, 'lack of manager's support' (17.9%, n=5) was not applicable to those interviewees who ran family businesses and therefore was not considered important by the majority of the interviewees.

In terms of the importance of social impact, only one interviewee considered 'negative comment from our community' (3.6%, n=1) an important factor for Web 2.0 adoption, which indicates that negative comments have little impact on primary producers' decisions regarding ICT adoption. Although negative comments did not seem to affect Web 2.0 application to SCM, however, positive comments may have significant impact on Web 2.0 adoption. VM2 said:

> *"Social influence can be divided into two parts. Negative comment is not important. If I need to use it I will still adopt it; while positive comments are a determinant as the people can teach me how to use it."*

The support of family members is significant. For example, S8 stated that his father's opinion was important in his decision making; and VM2 claimed that his daughter is IT savvy and her support is essential for him to use ICT.

The importance of social and external factors was also supported by the answers to Q.17. This was an open-ended question designed to identify any external factors affecting Web 2.0 application. Supply chain partners' requirements, market requirements, government incentives, compliance purposes, and family members' support were the external factors most commonly cited by respondents as factors encouraging them to use Web 2.0.

Based on the above justification, the extended determinant 'social and other external factors' has been incorporated into the revised research model.

7.5 MODERATORS AND THEIR RELATIONSHIP WITH DETERMINANTS

The moderators and their moderating effects were identified and justified using both quantitative and qualitative data. The quantitative data are largely based on the results obtained from the survey questionnaire and, in particular, extensive cross tabulation between the opinions relating to each determinant and the moderators. The qualitative information is based on the interpretation of the data obtained from the survey interviews and the follow-up interviews; and on observations made during the interviews, as well as on direct quotations collected during all interviews.

The moderators included in the revised model comprise: gender, age, 'number of customers' and 'technology experience'. 'Domain experience', which was a moderator in the original model, has been removed. Apart from these defined moderators, an undefined moderator 'educational background' is also discussed but not included in the research model due to the complexity of the survey results.

In the original model every moderator was assumed to have a relationship with all determinants. Those relationships were tested and justified as follows.

7.5.1 GENDER

Gender was found to have a moderating effect in the research model. However, since there were only two female interviewees in the survey, there can only be a low level of confidence about the moderating effect of this variable. Despite the small sample, however, there is some evidence to support the moderating effect of gender.

Although the two female interviewees accounted for only 7.1% of participants they demonstrated better levels of computer literacy and applied more ICT to their agribusinesses than their male peers. For example, one of the female interviewees had used a basket of ICT tools such as online web presence, Facebook page and online order system in her agribusiness. In comparison, only one of the male interviewees had used such a wide variety of ICT at the time of interview. In fact, only three male participants had an online web presence. Clearly, these findings require further research, as the tiny sample of highly computer-literate primary producers cannot be generalised in any effective way – but it is possible that female primary producers are more open to the potential benefits of ICT and Web 2.0.

Secondly, it was apparent to the investigator that female family members often have more ICT knowledge and are more likely to manage the in-house work, especially computer related tasks. For example, VM2 and S6 both mentioned that their daughters are IT savvy, and that their input was important for their own ICT use; S7 and M4 asked their wives who have more

IT knowledge to join the interviews; and D7 even asked his daughter to fill in the questionnaire on his behalf as he had little understanding of the topic.

The following evidence explores the moderating effects of gender which, in turn, supports the moderating role gender plays in the model.

7.5.1.1 Relationship between Gender and Performance Expectancy

Gender was found to have a moderating effect on Performance Expectancy and the effect was stronger for females. Although men are widely believed to be more positive and active in ICT adoption (Broos 2005; Gargallo-Castel et al. 2010), recent literature suggests that the effect of gender differences in ICT use is fading (So 2008). The present research results suggest, in fact, that female primary producers have a more positive attitude to applying ICT and Web 2.0 to the management of their supply chains. This is because, in a family business, the wife usually manages the in-house work, especially the IT-related work, while the husband spends most of his time on the farm work. This finding is supported by M1 who said:

> *"It is often the wife or the adult children who do the information input as they are often more technology savvy."*

Female primary producers may have more computer knowledge and management experience than their male counterparts and therefore may have better understanding of what benefits use of ICT, especially Web 2.0, can bring.

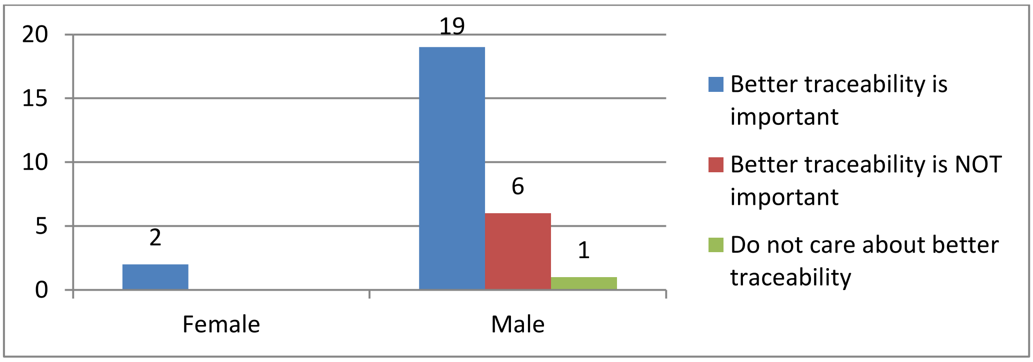

Figure 7-6: Cross Tabulation between Gender and Importance of 'Better Traceability' as a Motive

The quantitative data gathered from the survey may also support this moderating effect. Figure 7-6 shows that both female interviewees considered 'better traceability' as an important factor. Similarly, seven of the eight motives related to performance expectancy were considered important by both female participants, with only one exception – 'better access to market data' not being considered an important factor by M1.

Since there were only two female interviewees, it is not possible to confirm that the females were more positive on the ability of ICT in enhancing their SCM performance expectancy. Thus the finding can only indicate that female primary producers may have stronger feelings in performance expectancy than male primary producers.

7.5.1.2 Relationship between Gender and other Determinants

There is no strong evidence in either the quantitative or qualitative data to support a relationship between gender and the other three determinants: 'effort expectancy', 'communication quality' and 'social and other external factors'. For example Figure 7-7 shows that there is no obvious difference in regard the perspective of 'difficult to use' between female and male interviewees. This resulted in an indicative conclusion that gender is not a moderator for the above determinants.

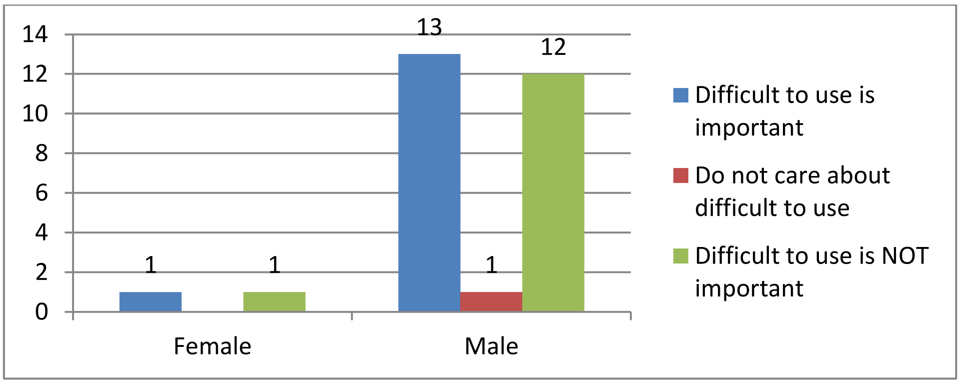

Figure 7-7: Cross Tabulation between Gender and Importance of 'Difficult to use' as an Obstacle

Given that only two female primary producers participated in the survey interviews, considering gender as a moderator of performance expectancy is an assumption and not representative at this stage. Further research may help to clarify this issue.

7.5.2 Age

Age was found to have a moderating effect in the research model. This was consistent with the answers gathered from the questionnaires. Five age groups were used for comparisons: under 30, 30-39, 40-49, 50-59 and 60+.

Age was identified as a moderator from three pieces of evidence. Firstly, it was discovered from the survey interview that younger farmers/fishermen growing up in the information and computer era had different opinions, perceptions and behaviour regarding ICT adoption in SCM compared with their older peers. For example, none of the three participants over 60 years old were using any kind of ICT in their SCM, while the younger interviewees (under 30 years old) had all used or even developed some kind of ICT for SCM. Secondly, although ICT technology has become more standard in recent times, the ways in which the interviewees used ICT differed depending on their age. Older interviewees were inclined to use ICT in a passive way, such as information searches, while the younger interviewees had adopted a more active approach. The younger primary producers not only obtained information online, but also actively contributed content online or had even developed an application themselves. Finally, two of the older interviewees S6 (60+ years old) and VM2 (60+ years old) mentioned the importance of their children’s support in using ICT. Some even asked their children to answer ICT-related questions. S5 working with his father in the seafood industry and VM5 working with his father on the farm answered the questionnaire on their fathers’ behalf. D7’s daughter helped D7 fill in the questionnaire.

The following evidence explores the moderating effects of age, which in turn, supports the moderating role that age plays in the model.

7.5.2.1 RELATIONSHIP BETWEEN AGE AND PERFORMANCE EXPECTANCY

Survey results indicated that age has a moderating effect on performance expectancy and the effect may be stronger the older people are. This is supported by the following indicative findings.

As discussed in ‘Section 6.4.3.7 Summary of the ICT and Web 2.0 use in the Fruit Supply Chain’, the fruit grower F1 (60+ years) was much more positive about the ICT and Web 2.0 adoption and has implemented more extensive ICT than the younger fruit grower F2 (30-39 years old).

There is also evidence from the survey results regarding the motives related to ‘performance expectancy’. All 3 interviewees older than 60 considered ‘better access to market data’, ‘better access to experts outside the enterprises’, ‘better traceability’, ‘faster transaction’ and’ better customer service’ as important. Thus, all three interviewees older than 60 expected ICT to enhance their SCM performance in these ways. The cross tabulation between age and the importance of 'better access to market data' is shown in Figure 7-8.

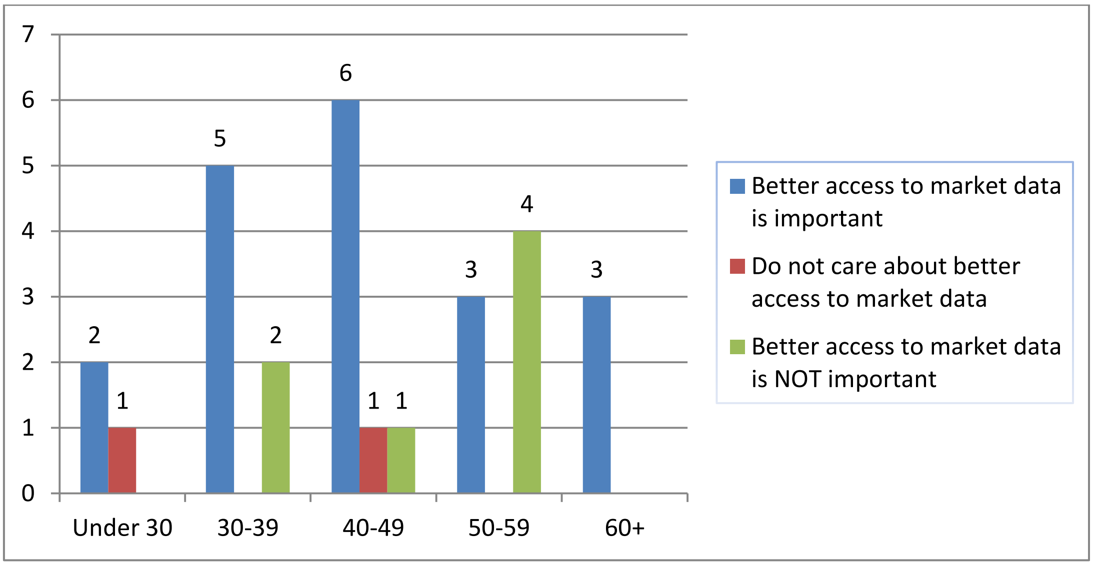

Figure 7-8: Cross Tabulation between Age and Importance of 'Better access to Market Data' as a Motive

This finding differs from those found by Venkatesh et al. (2003) that the moderating effect of ICT is stronger for younger workers. A possible reason for this unexpected result is that, in primary industry, while younger primary producers can obtain information and assistance from a range of channels and sources, older producers are lacking appropriate channels to achieve sufficient information and assistance, and therefore expect that ICT could help them overcome those challenges in their SCM. The other possibility is that in family operations, it is often the older (and less physically capable) members who value new technology which can assist them in continuing to achieve results their physical ability no longer supports. However, given the very small sample, the real reasons for this interesting finding need to be further investigated as answers may be influenced by other factors. As discussed in Section 7.2, for example, older interviewees may not have wanted to be viewed as ICT laggers who were not willing to invest in any ICT applications.

7.5.2.2 Relationship between Age and other Determinants

Neither quantitative nor qualitative data supported any relationship between age and 'effort expectancy', 'communication quality' or 'social and other external factors'.

In contrast to earlier findings (Venkatesh et al. 2003), no obvious evidence indicated any relationship between age and 'effort expectancy'.

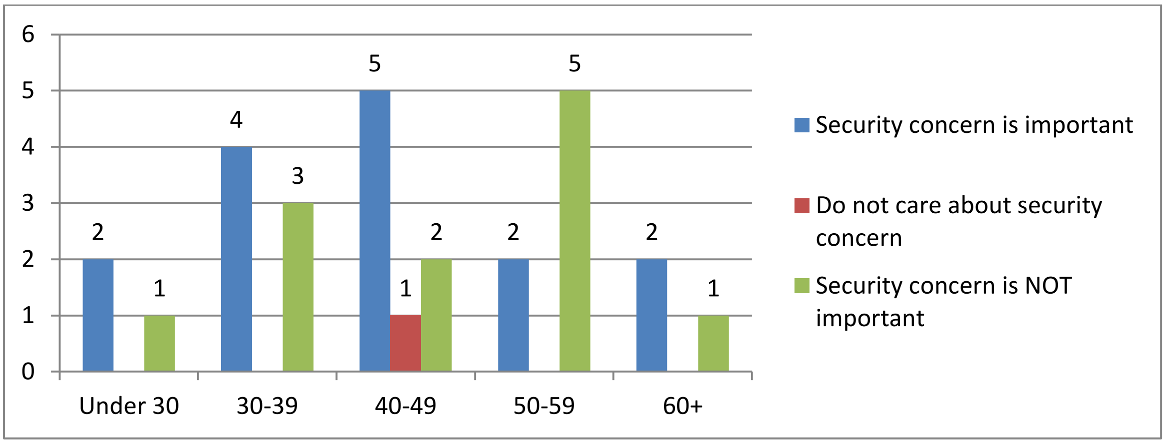

Figure 7-9: Cross Tabulation between Age and Importance of 'Security Concern' as an Obstacle

One of many cross-tabulation results displayed in Figure 7-9, between age and 'security concern', shows that there was no significant difference between the answers related to 'effort expectancy' in terms of age groups. Moreover the primary producers with sufficient IT knowledge or with poor IT literacy were scattered across a variety of age groups. These outcomes indicate that age is not a moderator of effort expectancy.

There are several possible explanations for this outcome. Firstly, technology developments have made technology use much easier than before, and user-friendly technologies can be used by all age groups. Secondly, over the past few decades, average IT literacy has improved substantially due to the prevalence of ICT.

No obvious relationship was found between age and 'communication quality', which indicates that poor communication quality, especially poor telecommunication infrastructure, is a prevailing challenge encountered by primary producers of all ages.

Similarly, no strong evidence was found to support any relationship between age and 'social and other external factors'.

As a result, it is only possible to conclude that age may have a moderating effect on 'performance expectancy' and that it is not a moderator of other determinants. The possible effects of age on 'performance expectancy' will have to be validated in future research. Thus the moderating effects of age have been removed from the research model except for the relationship between age and' 'performance expectancy'.

7.5.3 NUMBER OF CUSTOMERS

There is strong evidence to support the premise that 'number of customers' (which refers to the number of customers with which the agribusinesses were dealing) has a moderating effect in the research model.

For clarity, the 28 participants were classified as agribusinesses with either a large or a small number of customers on the basis of both the number of customers and the volume of sales. The agribusinesses selling to more than 10 end customers at small volumes were classified as agribusinesses with a large number of customers and were named 'with large number of customers' in the cross tabulation; while the remainder, with fewer than 10 customers and commodity sales were classified as agribusinesses with a small number of customers and were named 'with small number of customers' in the cross tabulation. As a result, seven participants' agribusinesses (S1, S5, S7, D1, D3, F1 and F2) were classified as agribusinesses with a large number of customers, while the others were considered agribusinesses with a small number of customers.

As discussed in Section 6.4.1.7 'Summary of the ICT and Web 2.0 use in Seafood Supply Chain' and 6.4.2.7 'Summary of ICT and Web 2.0 use in the Dairy Supply Chain' there were significant differences regarding ICT adoption between the interviewees with or without a large number of customers. The interviewees with a large number of customers were generally involved in direct sales to end customers; while the interviewees with a small number of customers were normally just involved in commodity production and sold only to a limited number of distributors, processors or supermarkets. It is difficult for primary producers to reach a large number of end customers and, more importantly, to manage a large volume of transactions without the use of ICT; whereas those primary producers dealing with a limited number of large buyers can still rely on pen and paper for their business management. This led to varying perceptions about ICT adoption. VM1 said:

> *"We currently have no plans to implement any sort of ICT program, as we sell most of our production to a small number of customers, mainly downstream processors. If we were selling to a large number of retail customers then we would be using some of the ICT components."*

Differing 'numbers of customers' may lead to different 'customer types'. As discussed in 'Section 6.4.1.7 Summary of the ICT and Web 2.0 use in Seafood Supply Chain' and '6.4.2.7 Summary of ICT and Web 2.0 use in the Dairy Supply Chain' these primary producers with a large number of customers were more likely to be selling to individual customers (families); while primary producers with a small number of customers were more likely to be commodity producers supplying to large processors or supermarkets. Thus this finding may support the assumption that 'customer type' is a critical factor affecting the agribusiness' owners willingness to adopt any ICT (Burke 2010).

Based on the survey data there was no empirical data to reliably measure the 'customer types' of the agri-food SMEs, while the measurement of 'number of customer' was easier and more reliable; so 'number of customers' has been used as a moderator at this stage. The following evidence explores the moderating effects of the 'number of customers', which in turn, supports the moderating role that it plays in the model.

7.5.3.1 Relationship between Number of Customers and Performance Expectancy

'Number of customers' has been identified as a moderator of performance expectancy. The effects are stronger for agribusinesses with a large number of customers.

This finding is supported by the cross tabulation results between 'number of customers' and the number of motives related to performance expectancy. For example, as shown in Figure 7-10, all interviewees with a large number of customers considered 'better traceability' an important motive; while seven interviewees whose agribusinesses have limited customers had the opposite view. Thus, the results suggest that better traceability was a motive for the interviewees with a large number of customers to apply ICT to SCM.

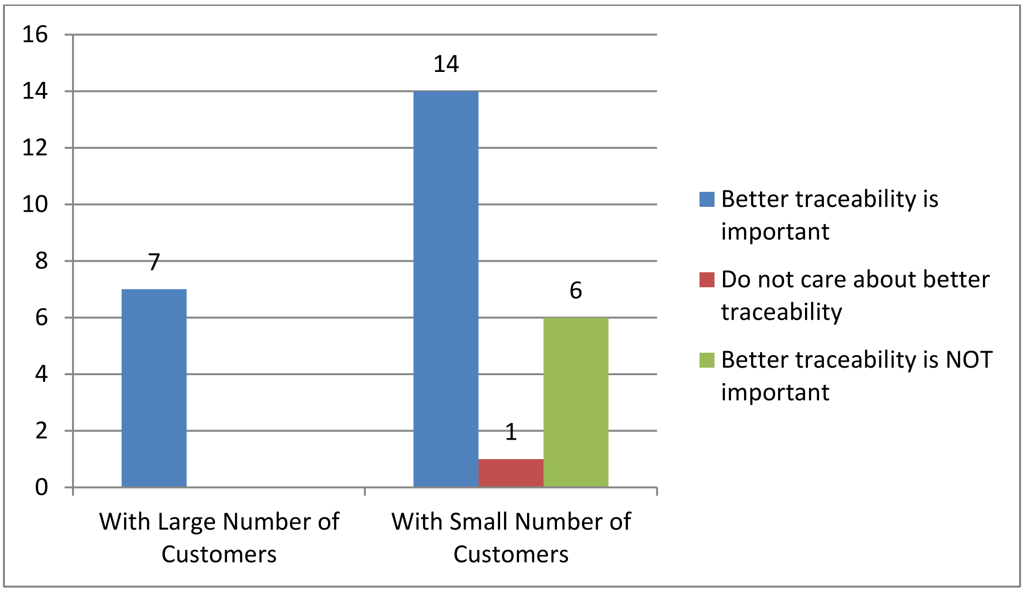

Figure 7-10: Cross Tabulation between Number of Customers and the Importance of 'Better traceability' as a Motive

A possible reason for the result is because the agribusinesses with a limited number of customers focus on production and simply sell their products to their processors and distributors. Although their customers (especially the large customers such as supermarkets) emphasise traceability and other supply chain information as important, the information that has been collected from the primary producers is not shared back with the primary producers. Thus some of the primary producers may not have any incentive to initiate ICT applications in their SCM, and may not realise the importance of ICT application in enhancing their SCM. By contrast, agribusinesses with a large number of customers need to manage many orders and a range of supply chain activities which would be difficult without ICT assistance. All the primary producers in this category considered ICT-enabled SCM important.

Similar results can also be found in their motives such as 'faster transaction', 'better customer service' and 'better transportation'.

These outcomes indicate that opinions about performance expectancy differed between those agribusinesses dealing with a large number of customers and those dealing with a small number of customers. Thus 'number of customers' is a moderator of performance expectancy.

7.5.3.2 Relationship between Number of Customers and Effort Expectancy

'Number of customers' was found to have a moderating effect on effort expectancy, and the effect is stronger for the agribusinesses with a small number of customers.

A strong relationship between 'number of customers' and effort expectancy is shown in the cross-tabulation results. Figure 7-11 depicts the contrasting results between agribusinesses with different numbers of customers. The majority of agribusinesses with a large number of customers may not consider 'difficult to use' an important obstacle for the primary producers to apply ICT and Web 2.0 to SCM.

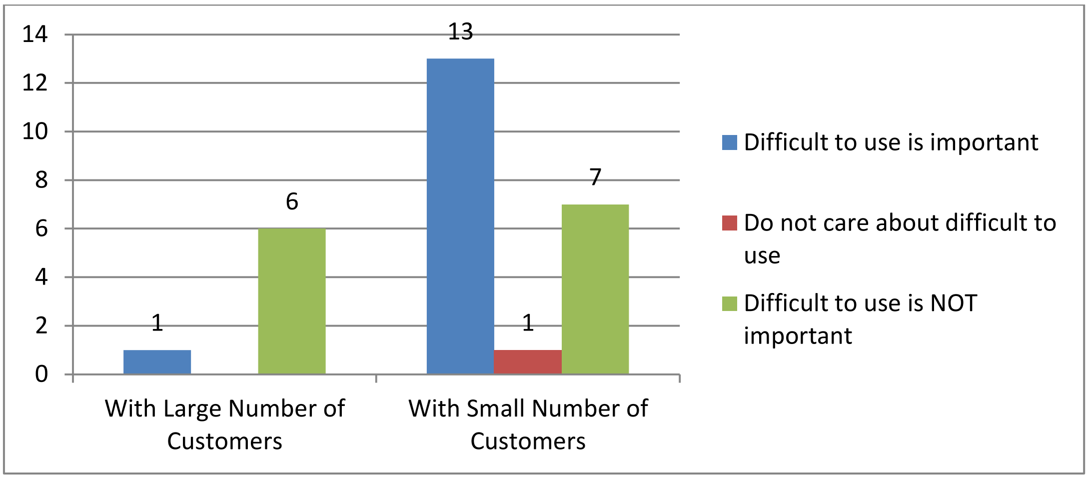

Figure 7-11: Cross Tabulation between Number of Customer and Importance of 'Difficult to use' as an Obstacle

One possible reason for the difference may be because the agribusinesses with a large number of customers may need to rely on ICT assistance for marketing and operational purpose, and therefore they were more likely to ignore the difficulties and challenges in applying ICT to their SCM. By contract, it was not essential for agribusinesses with a limited number of customers to apply ICT to their operations, and therefore they were less likely to put effort into ICT applications and were more concerned about the effort required for adoption.

Although effort expectancy was a general concern for the majority of the interviewees, those dealing with a greater number of customers may put greater weight on this issue, and therefore 'number of customers' is a moderator of effort expectancy.

7.5.3.3 Relationship between Number of Customer and Communication Quality

'Communications quality' was related to two key components: telecommunications infrastructure and enhanced communication features, such as real time and interactive communication. 'Poor telecommunications infrastructure' was considered a significant challenge for quality communications by the vast majority of the interviewees, while the SCM applications, especially Web 2.0 based applications which enable mutual communication and real time interaction, were considered important by those interviewees needing to sell their products directly to a large number of end customers. This suggests that number of customers has a moderating effect on the determinant 'communications quality'.

D3, selling dairy products directly to a large number of customers online, claimed that:

> *We desperately want to improve the speed and reliability the of internet service. And then just grow. Growing with what we already do.*

Thus the number of customers is a moderator of 'communications quality' and the effect is stronger for those agribusinesses with a large number of customers.

7.5.3.4 Relationship between Number of Customers and Social and Other External Factors

The cross-tabulation between 'number of customers' and the interviewees' ICT adoption opinions in regard to 'required by large customers' (in Figure 7-12) shows that the number of interviewees considering 'required by large customers' an important motive is significantly less in the 'large number of customers' group. A possible reason may be that agribusinesses with a large number of customers have their own sales channels and are not under the control of large buyers (usually large supermarkets or processors). Thus they are less likely to be affected by external factors, especially the requirements of large and dominating customers, and can make their own decisions regarding uptake of ICT applications.

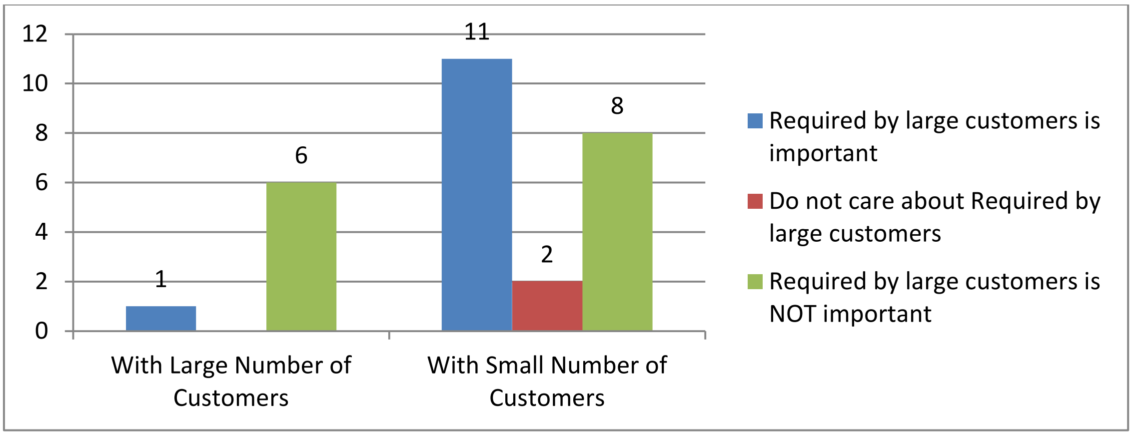

Figure 7-12: Cross-Tabulation between Number of Customers and 'Required by Large Customers' as a Motive

'Number of customers' is therefore a moderator of 'social and other external influence', and the effect is stronger for agribusinesses with a limited number of customers.

The moderator 'number of customers' has therefore been incorporated into the revised research model.

7.5.4 TECHNOLOGY EXPERIENCE

It was necessary to distinguish those primary producers with more technology experience from primary producers with little (or less) technology experience. Now that use of the Internet and email are so prevalent, experience of these two ICT applications was not a suitable indicator to identify level of expertise in ICT use, especially for SCM. However, web-based SCM platforms and software packages provided by customers and suppliers can be treated as indicators of technology experience in the research model. 10 out of 28 interviewees fell into this category (discussed in 'Section 6.3.6 Existing ICT use in Supply Chain Management').

Thus those interviewees with SCM application experience have been classified as "more technology experience" users, while the others are classified as "less technology experience".

There is strong evidence that 'technology experience' has a moderating effect on the research model, and this can be justified by the experience of S1 whose attitude to ICT use changed dramatically between the initial survey and the follow-up interview, following his exposure to the potential usefulness of Web 2.0 applications.

This participant's change in attitude to the perceived obstacles and motives was a direct result of his exposure to a simulated Web 2.0-enabled SCM system. The follow-up interview showed that S1 had markedly changed his former approach and was now making significant use of ICT, especially Web 2.0 technologies, for his SCM activities: behaviour which was in total contrast to his former reluctance to use ICT. S1 said:

> *"The motives and obstacles are completely changed as compared with what I told you in the first interview. We are still doing what we used to do but just apply the ICT to our business. It took a while for us to adapt to it but now everything is good. Now the only obstacle is the time."*

The next Section explores the moderating effects of 'technology experience' which, in turn, supports the moderating role 'technology experience' plays in the model.

7.5.4.1 RELATIONSHIP BETWEEN TECHNOLOGY EXPERIENCE AND PERFORMANCE EXPECTANCY

'Technology experience' was found to have a moderating effect on 'performance expectancy', and the effect was stronger for interviewees with more 'technology experience'. That is, those interviewees who had previously used SCM applications were more positive about using Web 2.0 than interviewees lacking technology experience.

The cross-tabulation depicted in Figure 7-13 shows that only 3 in 28 interviewees did not believe they could achieve better book keeping/record keeping by applying ICT to SCM – and these three negative participants were all lacking any prior SCM application experience and might therefore be unable to imagine the benefits such technology would bring with it.

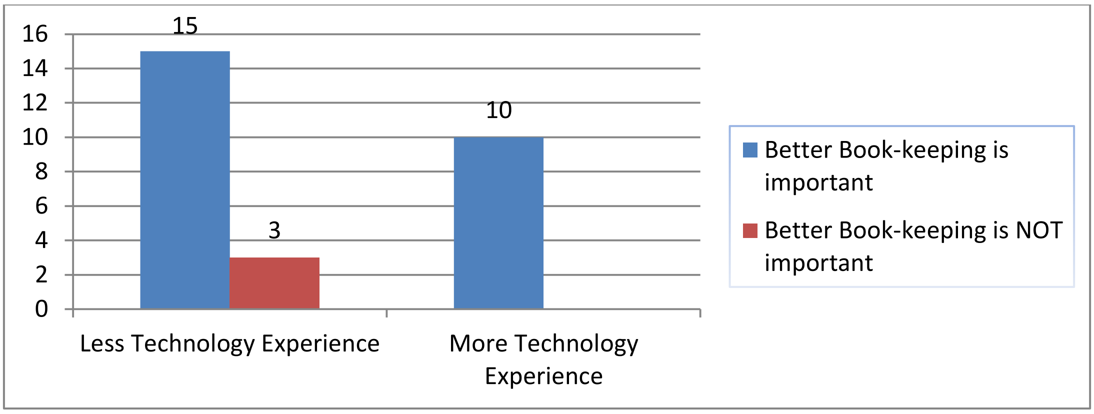

Figure 7-13: Cross-Tabulation between 'Technology Experience' and Importance of 'Better Book-keeping' as a motive

Similar results were also found in the interviewees' opinion of 'better access to market data' and 'better customer service'. It is apparent from Figure 7-14 that 8 of the 18 people with 'less technology experience' did not consider 'better access to market data' an important factor. In the group with more technology experience, only one of the ten was negative about ICT's potential to provide better market access.

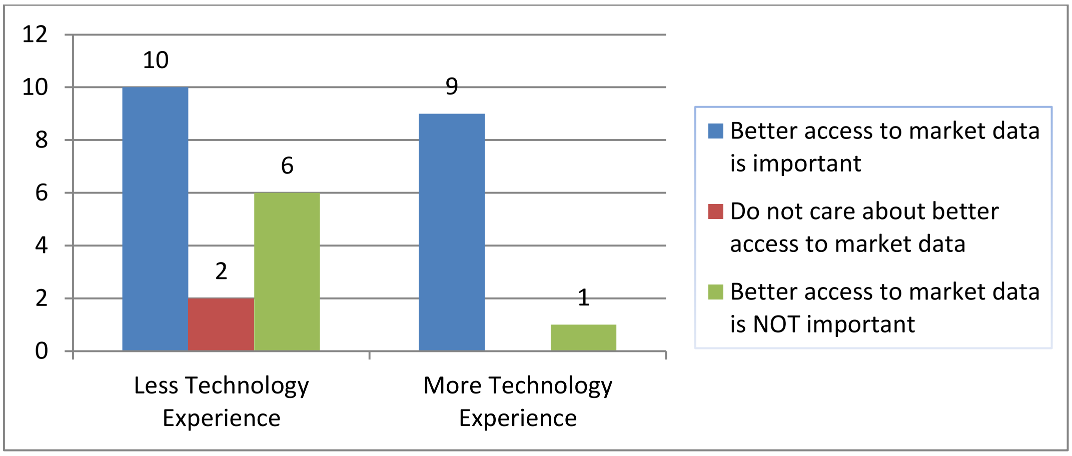

Figure 7-14: Cross-Tabulation between 'Technology Experience' and Importance of 'Better Access to Market Data' as a Motive

Primary producers with less technology experience are accustomed to their way of accessing market data, and less convinced by the advantages of using ICT. S2 said:

> *"A lot of fishermen don't look at the business data; they just do it by experience."*

This finding suggests that those interviewees with greater technology experience may have a better understanding of the advantages brought by ICT application to SCM, and more positive views on adoption of ICT and Web 2.0 overall.

7.5.4.2 RELATIONSHIP BETWEEN TECHNOLOGY EXPERIENCE AND EFFORT EXPECTANCY

'Technology Experience' was found to have a moderating effect on 'effort expectancy' and, in particular, the effect is stronger for those interviewees with more 'technology experience'.

One possible reason for this finding is that related SCM application experience enables users to better understand the actual challenges in applying ICT to their SCM.

As shown in Figure 7-15, 'reliability of the SCM software' was considered an important inhibitor to ICT adoption by 21 out of 28 (75.0%) interviewees. This result may indicate that the current rural SCM applications, most of which are extremely limited in terms of features and effectiveness, are important inhibitors to ICT adoption. Only 10% of the interviewees (1 in 10) who had previously used some form of SCM application, considered the reliability of SCM software was not an important obstacle to the adoption of ICT for SCM, compared with 33.3% interviewees (6 in 18) without any SCM application experience. This finding indicates that those people who have previously used some form of SCM application have a better understanding of ICT utility and can identify the challenges in applying ICT to SCM.

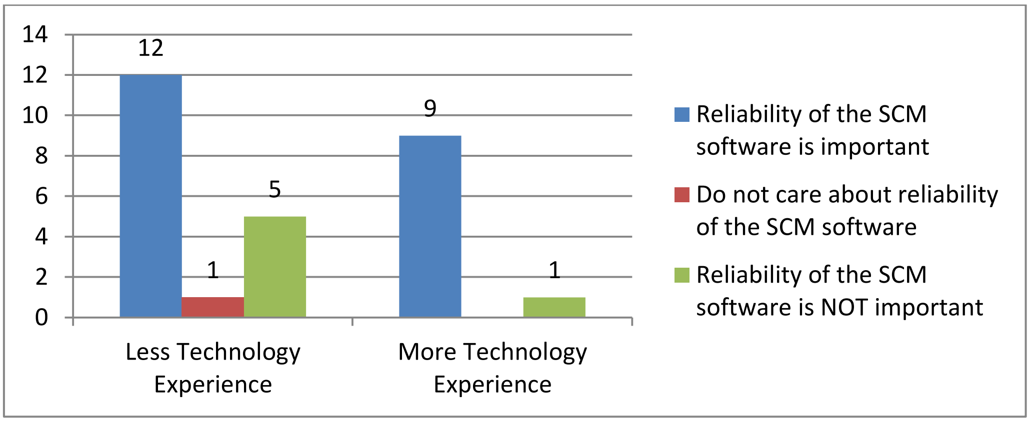

Figure 7-15: Cross-Tabulation between 'Technology Experience' and the Importance of 'Reliability of the SCM software' as an obstacle

Similar results were found in the interviewees' opinions regarding 'flexibility of the SCM software', 'difficult to use' and 'lack of IT technical support' as shown in Figure 7-16.

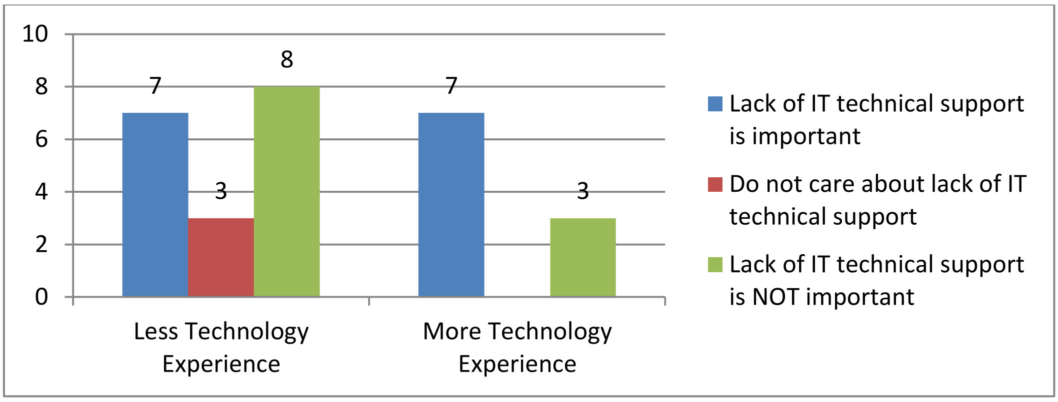

Figure 7-16: Cross-Tabulation between 'Technology Experience' and the Importance of 'Lack of IT Technical Support' as an Obstacle

Thus 'technology experience' has been included as a moderator of 'effort expectancy' in the revised research model.

7.5.4.3 RELATIONSHIP BETWEEN TECHNOLOGY EXPERIENCE AND OTHER DETERMINANTS

There is no strong evidence indicating a relationship between 'technology experience' and the two other determinants – 'communications quality' and 'social and other external factors'.

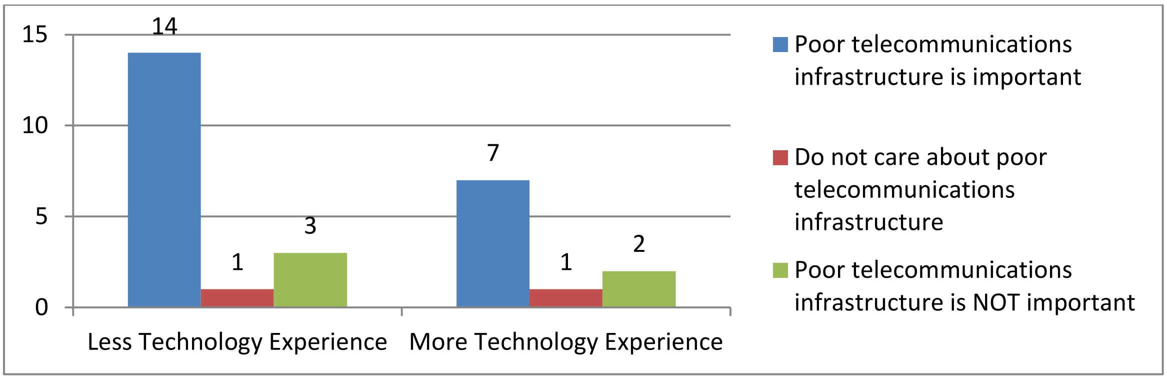

Figure 7-17: Cross-Tabulation between 'Technology Experience' and the Importance of 'Poor Telecommunications Infrastructure' as an Obstacle

For example, the cross-tabulation between technology experience and 'poor telecommunications infrastructure' depicted in Figure 7-17 shows similar results for THE interviewees with different degrees of technology experience in terms of 'poor telecommunications infrastructure'.

Thus, the relationship between 'technology experience' and both performance expectancy and effort expectancy are retained in the model, whereas the relationships between 'technology experience' and 'communication quality' / 'social and other external factors' have been removed from the revised model.

The results, however, should be viewed with caution as the way in which users were categorised may have biased the results of the analysis. Interviewees' previous level of experience in using some form of SCM software was employed as a criterion to categorise participants: those interviewees with SCM software experience were classified as 'more technology experience'; while the remainder of the interviewees were classified as 'less technology experience'. But while this categorisation enabled the analysis of moderators very effectively, it had two potential weaknesses: firstly, primary producers' limited knowledge of the ICT industry may have meant that they could not clearly determine whether they had previously used some form of SCM software; and, secondly, the definition of SCM software in the questionnaire was so broad that it might not have been possible to distinguish actual SCM software users from those who had merely uses platforms such as eBay for online auctions and shopping.

The definition of 'technology experience' should therefore be clearly specified and the impacts of 'technology experience' on Web 2.0 application should be further investigated in future research.

7.5.5 DOMAIN EXPERIENCE

The variable 'domain experience' was a moderator in the original research model, but was found to have only an indirect impact via 'age' and 'technology experience' rather than a direct impact on ICT adoption. Thus different numbers of years of farming experience do not directly lead to differing perceptions of the usefulness of Web 2.0 adoption. Nonetheless, in this survey, those primary producers with more than 20 years of experience were all traditional farmers with less technology experience; while those primary producers with fewer years of farming experience were either younger or sea change farmers with more technology experience.

Domain experience has therefore been removed and has not been included in the revised research model.

7.5.6 UNDEFINED MODERATORS: EDUCATION BACKGROUND

In regard to education background, interviewees with differing levels of educational background may also have differing opinions regarding ICT adoption. As the follow-up interviews indicated, primary producers' education levels varied significantly: ranging from graduate certificates to master's degrees; while fields of study ranged from financial planning, to applied science, to agriculture; and the status could be completed or ongoing or withdrawn. With such a limited number of interviewees, it was too complicated to identify the moderating effects of education background; and the participants' widely varying education backgrounds made it difficult to analyse any moderating effects on each determinant. Thus this variable has not been included in the revised research model, although it seems likely that future research into this relationship may well yield some very interesting findings.

The moderating effects of those moderators which were included in the revised research model are summarised in Table 7-5.

Table 7-5: Summary of the Moderators and their Effects

Determinants	Moderators	Explanations
Performance Expectancy	Age	Effect stronger for older primary producers
	Gender	Effect stronger for female primary producers
	Number of customers	Effect stronger for primary producers with a large number of customers
	Technology Experience	Effect stronger for primary producers with more technology experience
Effort Expectancy	Number of customers	Effect stronger for primary producers with a small number of customer
	Technology Experience	Effect stronger for primary producers with more technology experience
Communication Quality	Number of customers	Effect stronger for primary producers with a large number of customer
Social and Other External Factors	Number of customers	Effect stronger for primary producers with a small number of customer

7.6 CONCLUSION

This Chapter has presented an analysis of the results survey, focusing on the modifications to the research model which followed from the empirical data.

The survey findings suggested that the majority of participants were positive about applying ICT – and especially Web 2.0 – to SCM. The limited telecommunications infrastructure available in rural Tasmanian, rather than managerial issues, appeared to be the most significant obstacles to ICT and Web 2.0 adoption.

'Performance expectancy' was a driver for the agri-food SMEs to apply ICT (especially Web 2.0) to their SCM and many of the participants expect Web 2.0 to be able to overcome the weaknesses of existing SCM applications. These primary producers were busy with production activities and would like to use technology if it is useful and easy-to-use. They would probably not use ICT if it was difficult or time consuming. So 'effort expectancy' is also a determinant. 'Better communication quality' was another driver for Web 2.0 adoption, although ICT adoption was challenged by inadequate telecommunications infrastructure in rural areas. Web 2.0 adoption was not only a question of technology and internal resources, but was also affected by some social and external factors such as family members' support, the character of the products produced by the participants, industry readiness; and supply chain practice in sub-sectors. So 'social and other external factors' is also a determinant in the research model.

Interviewees' perspectives were moderated by 'gender', 'age', 'number of customers' and their experience of using SCM systems.

These findings, while extremely interesting, are clearly in need of some validation from industry experts. Following this analysis of the survey results, the next Chapter presents the results of a focus group which was designed to validate the revised research model.

Chapter 8

Data Validation

8.1 INTRODUCTION

The outcome of the key informant interviews (stage 1) and the surveys employing semi-structured interview as data gathering technique (stage 2) are presented in Chapter 5, Chapter 6 and Chapter 7 respectively. Chapter 8 validates the revised theoretical model developed as a result of the findings from those two preliminary stages.

Focus groups are a nominal group technique designed to identify consensus as the outcome of discussion focusing on particular topics (Tashakkori & Teddlie 2003, p. 308). This approach falls somewhere between participant observation and in-depth interviews (Morgan 1996). Focus groups also provide an effective platform for generating and assembling the views and knowledge of a variety of expert stakeholders (Lichtenstein & Swatman 2003).

The overall study was designed to investigate whether the emerging Web 2.0 technologies have the potential to support and enhance primary producers' agri-food supply chain management. 'Focus group' is employed as the method to validate the data gathered from the previous stages for the third and final stage of this project. The focus group results have been triangulated with the information and data gathered from the literature review, the survey and the focus group. The triangulated outcomes have been used to finalise the research model. The stage described in this chapter is illustrated in Figure 8-1.

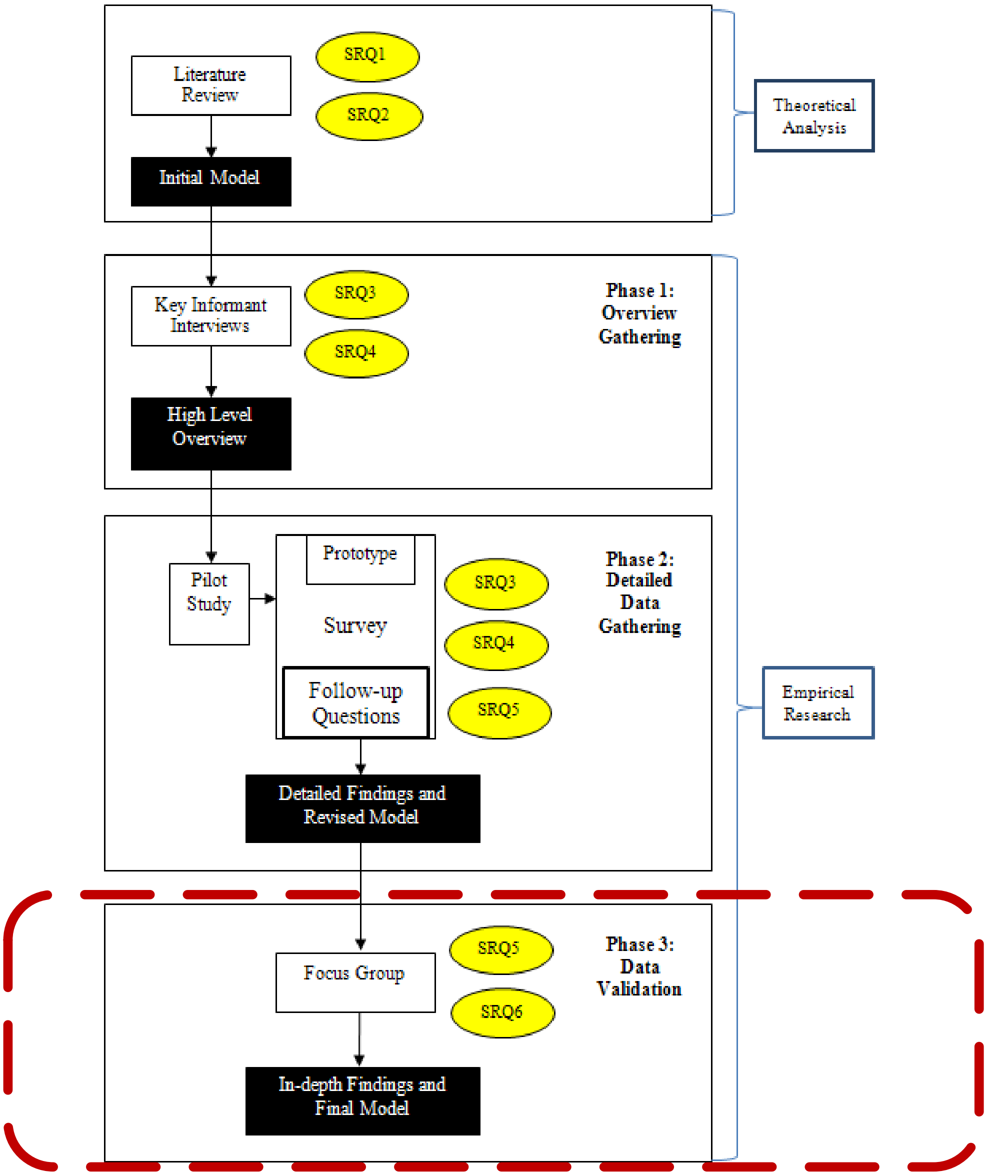

Figure 8-1: The Stage Described in Chapter 8

The answers of the following SRQs, as designed, will be obtained in this chapter:

SRQ5: What differences exist between each agri-food sub-sector in applying Web 2.0 technology to their supply chain?

SRQ6: How effective are Web 2.0-based approaches to supply chain management for Tasmanian agri-food SMEs?

The remainder of this chapter will proceed as follows. Section 8.2 outlines the objectives of the focus group, the procedures of the focus group is described in Section 8.3 followed by

Section 8.4 which describes and discusses the findings of the focus group. Based on the overall outcomes, the research model is finalized and presented in section 8.5. Section 8.6 concludes the whole chapter.

8.2 FOCUS GROUP OBJECTIVES

The objectives of the focus group were to:

- assess the accuracy of the research model and its components;
- determine the overall usefulness of the research model to the agri-food industry.

8.3 FOCUS GROUP PROCEDURES

This section describes the procedures of the focus group, including selection of the moderator and the participants, composition of final participants, time and venue of the meeting, and the schedule of the focus group.

8.3.1 PREPARING FOR THE FOCUS GROUP

The focus group planning and preparation dictated the choice of a moderator or facilitator and 4-6 focus group members. The moderator needed to be an experienced facilitator who was not involved in the research project and who could take a neutral position in facilitating the discussion. Nonetheless, it was essential for the moderator to have sufficient knowledge about social science research methods in general and the research project in particular, because "you cannot explain something that you do not understand." After a search and intensive screening of potential facilitators, Professor Paul Swatman was identified as a suitable moderator for the following reasons: firstly, he has worked as a researcher in the Information System domain for more than 20 years and was deemed competent to drive the discussion; secondly, he had already attended the initial project seminar presented by the student investigator and had a good understanding of the project without involvement; thus he was competent to guide the discussion without having a biased opinion.

With regard to the selection criteria for the participants, it was necessary for the participants to have considerable interaction and presentation skills as well as adequate knowledge of model validation. This was because the research model was complicated and there was limited time for the discussion. To be representative, the participants were required to have a mix of academic and industrial backgrounds and to have knowledge in the ICT, agri-food and SME domains.

Potential focus group participants were asked to discuss only non-sensitive material within their own field of professional expertise. They were contacted directly, by means of email or telephone at addresses / phone numbers obtained from publicly-listed directories and, more reasonably, by referees.

Invitations were sent to the moderator and seven other people deemed suitable for the discussion. Six of them expressed their willingness to participate. However, the focus group discussion required the participants to travel to and from the Sandy Bay Campus of the University of Tasmania – a time consuming and exhausting process for potential participants residing across the state – and it was difficult to identify a mutually convenient time for all those busy people. Eventually, one moderator and four participants attended the focus group.

The number of participants was manageable and suitable for a focussed discussion session. The backgrounds of the participants were broadly representative. For the sake of anonymity, those four participants are named FG1, FG2, FG3 and FG4 in this thesis. FG1 was the chairman of a local small business association, FG2 was a researcher focusing on the agriculture domain, FG3 was a researcher focusing on the Information System field and FG4 was the chair of a local vegetable committee.

8.3.2 FOCUS GROUP DISCUSSION

The focus group discussion was held on 31st January 2013 at the University of Tasmania, Sandy Bay campus. In order to follow the discussion without participation, the investigator monitored the discussion in another room via the video conference system.

Given that the research project is an emerging topic and the participants were not expected to have a good understanding of it, a presentation briefly introducing the project was made by the student investigator prior to the focus group discussion. Following the presentation, the meeting was handed over to the moderator.

The meeting started with the researcher greeting the participants and briefly explaining the purpose of the focus group. For the sake of clarity, booklet printouts describing the research model were given to each participant. The booklets described the original research model, the development of the revised research model and the revised research model. The survey results summarising the motives and obstacles for primary producers to apply ICT to SCM were included in the appendix, along with the questionnaire.

The second stage of the focus group was a facilitated discussion aimed at validating the research model and obtaining the participants' opinions about ICT and Web 2.0 applications in agri-food SCM. The moderator began by introducing the research model and, in particular, the determinants and the moderators of the research model. The moderator then facilitated the discussion, following an indicative guideline designed for the focus group.

8.4 FOCUS GROUP DESCRIPTION AND DISCUSSION

The focus group discussion produced a generally positive response towards validating the research model. Although the number of attendants was small, the participants were broadly representative and had diversified knowledge backgrounds which permitted broad information coverage.

In this section, the outcomes of the focus group discussion have been sorted into three categories: determinants of the research model, moderators of the research model, and the values and weaknesses of the model. The discussions and the results from the meeting are then summarised.

8.4.1 DETERMINANTS

This section summarises the focus group discussion about the four determinants that were identified in the survey. They are 'performance expectancy', 'effort expectancy', 'communication quality', and 'social and other external factors'. Their definitions are re-introduced as follows.

'Performance expectancy' is defined as the degree to which an individual believes that using the system will help him or her to attain gain in job performance as well as enhance the business performance.

'Effort expectancy' is defined as the degree of ease associated with the use of the system.

'Communication quality' is defined as the degree to which an individual believes that he or she can use the system to achieve communication enhancement. The definition of 'Communication quality' is two-fold. One is the degree of communication enhancement associated with the use of the system, and the other is the magnitude of the challenges related to telecommunication infrastructures such as the Internet connectivity in rural, the Internet accessibility on working site and the cost of the connection.

'Social and other external factors' is defined as the degree to which an individual perceives that important others or external factors may affect his or her use of the new system.

8.4.1.1 PERFORMANCE EXPECTANCY AND LIFESTYLE ENHANCEMENT

FG1 and FG4 believed that the objectives of businesses are to achieve economic benefit, and therefore performance improvement which could lead to more economic benefit was an important driver for the primary producers to adopt Web 2.0 technologies. FG1 said:

> *"You know, if you are there to play, have fun, but if you are seriously in business, then something of this nature then has the potential to enhance your business."*

Similarly FG4 said:

> *"I see probably the biggest driver in this model as being the performance expectancy thing. Because I sort of think to myself, well why would you do it. If you are in business, why do you do anything?"*

Although FG2 agreed that 'performance expectancy' is a driver for Web 2.0 applications, she argued that there might be more fundamental factors affecting the adoption decision. FG3 argued that 'performance expectancy' is a general driver for the agri-food SMEs to make business decisions, and in particular, technology adoption decisions, and this driver is not restricted to the adoption of ICT and Web 2.0 technologies. Moreover, FG3 considered that there are different priorities of adoption decisions which depend on the impacts of the adoption. For example, according to FG3, in her past studies the primary producers prioritised operational technology adoption over information technology adoption as the adoption of operational technologies such as irrigation systems can bring immediate and obvious benefit to the agri-food SMEs. FG3 said:

> *"Particularly for an agri-food sector, anything that was to do with irrigation or quarantine or anything – absolutely. Straight onto that, no question what-so-ever. Anything to do with business productivity, not so important, not a real priority. So I absolutely agree with what you are saying."*

There was a discussion about justifying the combination of 'cost savings' and 'time savings' into 'performance expectancy' in the revised model. FG3 believed that there should be a more inclusive term to cover the benefit which might drive primary producers to apply Web 2.0 to their SCM. FG3 then agreed to use the inclusive term, 'performance expectancy', to represent all the benefits such as cost savings and time savings. Nonetheless FG3 argued that the term 'performance expectancy' did not cover the benefits related to non-economic factors which may also affect some primary producers, especially those who treat farming as a lifestyle rather than a growing business. She felt that the different business goals underpinning their agribusiness operations might have a substantial impact on their opinion as to the benefits of Web 2.0 adoption. FG3 said:

> *"I am just wondering whether this needs to encapsulate or maybe it doesn't, but to me the thing that is missing is some kind of motivation for actually undertaking business ... This was way back when e-commerce was just coming about. That they were not interested in exploring the options because they didn't actually want to get any bigger and they wanted to maintain something that was sustainable and they'd found that."*

She eventually agreed that the term, 'performance expectancy and lifestyle enhancement', proposed by the moderator, was a more appropriate surrogate of 'performance expectancy'.

There was a discussion about the advantages of Web 2.0 technologies which can enhance the primary producers' performance in agri-food supply chains. FG1 and FG2 expressed their concerns over the sustainability of Tasmanian dairy farmers and growers in the context of increasing competition and globalisation due to their small sizes. FG2 said:

> *"And you know, the average size of our vegetable producing guys here in Tassie is just over 200 hectares. They produce about 33 hectares of veggies on average every year. And that's not going to cut the mustard into the future. They are going to fall by the wayside…Yep. You are either in or out. You know. You need to somehow get bigger and whether that is 3 or 4 people that neighbour each other getting together to have that scale of production."*

The focus group participants saw Web 2.0 as a potential solution to enable the small growers to enter in to collaboration to overcome the disadvantages of small sizes. FG2 and FG3 considered that Web 2.0 applications might act as potential enablers for the smaller growers to overcome the disadvantages of small sizes because of its social networking and collaborative features. For example FG2 thought Web 2.0 technologies might be used for co-development of value-added products by the primary producers and end customers. FG2 said**:**

> *"Yes, and in that whole collaborative, cooperative kind of structure, I see there are lots of potential applications for this sort of technology to be of assistance with that."…… "You can also look at it from the other end too. If you have got a group of producers that are trying to develop a new product or some sort of value-added product I think that there is scope for this to work in a similar way to what the Simplot guys are doing. In that, getting feedback and getting information from the consumer end of the market about what their real needs and wants are."*

FG3 said:

> *"It's the whole thing. You know, both words, Co-opetition stuff, to independently running your own business but for things like large marketing purpose, selling to a large player and having more impact as a larger group in a supply chain in terms of negotiation."*

FG4 mentioned that the marketing potential of digital social networks are one of the strengths of Web 2.0. He felt that this strength could be used to assist the primary producers to explore new sales channels and therefore reduce their reliance on large single customers. According to FG4 many farmers in Tasmania have traditionally supplied to a limited number of large customers. Such a distribution of customers put the primary producers in a weak position facing considerable risk. They have little bargaining power and their agribusiness would be seriously damaged if they were to lose the contracts of large customers. He said that many primary producers (including those suppling to large processors such as McCain Foods (Aust) Pty Ltd and Simplot Australia) were starting to consider diversifying their products and customers. FG4 said:

> *"Then again, I see a lot of people that potentially grow for Simplot and thinking that, you know, my business focuses around what I grow for the processing industry, and really should I be thinking my business should be more diversified so that I don't have the dependence on one income source."*

The focus group participants considered traceability to be an increasingly important issue as it is related to the food safety. The potential enhancement of traceability was considered to be a driver for primary producers to adopt Web 2.0. They were amazed to see the capabilities of the iFish app mentioned earlier, especially its traceability function. The iFish app was developed by a fisherman using his smartphone as platform and is a mashup of the Google Map service and the catch calculation function.

Thus the focus group considered that Web 2.0 applications have great potential to enhance the primary producers' collaboration, marketing, and traceability performance because of its social networking and collaborative features. All focus group participants agreed that 'performance expectancy' is an important driver encouraging primary producers to apply ICT and especially Web 2.0 to their SCM. Moreover, a more inclusive surrogate term, 'performance expectancy and life style enhancement', was proposed. The discussion also concluded that 'performance expectancy' is a general term and that there are a range of business performance indicators that can be improved by applying different kinds of technologies including, but not restricted to, ICT and Web 2.0 technologies. They felt that primary producers prioritise the technologies that can bring obvious and immediate benefits.

As a result, 'performance expectancy' was confirmed as a determinant and revised as 'performance expectancy and life style enhancement' to cover any ICT applications for the agribusiness that are not focused on growing the business.

8.4.1.2 EFFORT EXPECTANCY

'Effort expectancy' is defined as the degree of ease associated with the use of the system.

FG1 indicated that effort expectancy is an important driver for using ICT and Web 2.0 and that the ease of use is as important as the usefulness. This is because in most cases one person fundamentally runs the business and this person would be too busy to learn and use ICT if it requires significant time and effort. FG1 said:

> *"Another factor is there is only, the person, even if it is up to two or three of them, but fundamentally the person is the business, and therefore is everything. Dare I say, the digger of holes, the planter, the… Runs the telephone, answers the phone, does the payroll, does the superannuation, handles the maternity leave payments, superannuation tax and everything. Though there is a plus and a minus. The minus is*

> *how the hell do they do it. The plus is the technology is going to help them to do a lot more than they might have otherwise have done."*

The moderator (person) thought that 'effort expectancy' was a determinant for the primary producers. The moderator (person) suggested that:

> *"I mean, you know, the amount of effort involved in doing something… It is obviously a negative influence. The harder it is the less people will do of it. That's clear."*

The group had little further to add on this issue, as they were in agreement that it was important and self-evident.

Based on the above findings 'effort expectancy' is therefore retained as a determinant in the final research model - RuWebTAM 3.

8.4.1.3 COMMUNICATION QUALITY

'Communication quality' is defined as the degree to which an individual believes that he or she can use the system to achieve communication enhancement. The definition of 'Communication quality' is two-fold. One is the degree of communication enhancement associated with the use of the system, and the other is the magnitude of the challenges related to telecommunication infrastructures such as the Internet connectivity in rural areas, the Internet accessibility on the work site and the cost of the connection.

FG4 emphasised that enhancement of communication quality is a distinguishing strength of Web 2.0 applications. FG4 said:

> *"You know, and the big change has been, the simple availability and use of these smartphone. Of these smartphones. When it was web based, it was a different scenario. But now they are all using smartphones, and the smartphones are what are driving it? Because you know they are in the paddock, they can do it. They're in the shed, they can do it. If they are on the tractor, they can do it. I think that was the big change."*

With the advent of smartphones and tablets, FG4 believed that the Web 2.0 technologies are able to change the landscape of ICT applications in the agri-food industry in the following ways. Social networking technology would permit them to share their information and daily life with their peers living at a distance and, closely related to social networking, the collective intelligence principle of Web 2.0 will permit them to gain information and answers from their friends and peers straight away. Such mutual communication principles will enable end customers to express their opinions on agri-food products, and this will permit the processors to understand customers' demands and changing preferences. As a result, food products will be able to fulfil customers' needs. Customers' satisfaction and loyalty will therefore be improved. The natural combination of smartphones and the Web as a platform principle can also potentially help the primary producers overcome the weakness of the immobile desktop and permit them to manage and synchronise data while working in the field, in the shed or in the truck.

Furthermore, FG4 thought that the 'impatience of the society' is a driver which pushes or encourages the primary producers, especially the younger generation, to apply Web 2.0 in order to obtain immediate answers.

> *"I suppose the other thing that I see really drives is our impatience, as a society. Like, everyone wants to know everything right away, now. And that's where it comes from, for younger people."*

The 'impatience of the society' may be a motive included in the 'social and other external factors'.

Both the literatures and the empirical study support the notion that 'communication quality' is a determinant for the adoption of Web 2.0. Communication quality for farmers is seen to have two aspects. One positive aspect is the potentially easy and useful dialogues enabled by Web 2.0 technologies. However a negative aspect that counters this is the poor communication quality resulting from the lack of adequate telecommunication infrastructure in rural and regional areas. Since the focus group participants tended to be agreed on the importance of the 'communication quality' in applying Web 2.0 technologies to SCM, this factor has been kept as a determinant in the research model.

8.4.1.4 Social and other External Factors

'Social and other external factors' is defined as the degree to which an individual perceives that important others or external factors may affect his or her use of the new system.

As the above heading implies, this umbrella term consists of two general factors; 'social factors' and 'other external factors apart from the social factors'. All the participants tended to be in agreement on the issue of 'social and other external factors' as a determinant or factor influencing the intention to use Web 2.0 technologies.

The focus group participants felt that the social features of the Web 2.0 technologies have the potential to enhance the primary producers' information management and enable the evolving communication methods besides traditional phone call in rural communities where the majority of the primary producers are located. FG4 said:

> *"They (the young primary producers) are communicating with other people that use a similar (social) technology that they might be scrounging information from. You know, friends at times that they've got an issue, they want an answer. They are scrounging… They are wondering how they resolve their issues as quick as they possibly can."*

FG3 considered the maturity of technology, and an individuals' confidence over the technology as possible social and external factors. These two factors were believed by FG3 to outweigh the importance of personal technology experience such that:

> *"Maybe it (technology maturity or individual's confidence in the technology or both) is, maybe it is part of that, the social influence in, maybe or the social externalities of that."*

However, the moderator (person) considered both 'maturity of the technology' and 'an individual's confidence' are constructs of the 'communication quality'. In particular, the maturity of technology was considered as a factor which can influence 'communication quality' and that an individual's confidence with a Web 2.0 technology can impact 'communication quality'. He said:

> *"I guess it is a part of the communication quality stuff."*

The focus group agreed that the character of the products in different sub-sector may have significant impacts on the usefulness of the ICT application in the SCM. Basically, in high value supply chains, larger value IT investments in both time and money are worthwhile. FG1 said:

> *"I'd like to say a supply chain value is a big difference. You are talking about crayfish at fifty bucks, or more…The differences there in terms of what can happen. Bulk, in the case of high value seafood, the ability to put it on a plane."*

FG4 added that shelf life of the products may have an impact on the suitability of online sales, and therefore further influence the ICT application:

> *"Shortage of shelf life that, you know live products (have)…"*

In addition, FG3 claimed that the attitude and support from industry association is important and said:

> *"They (the primary producers in wine industry) were very well supported by their industry association for looking at information and operational technology as well. So, they might actually be quite a different case than veggies and dairy guys."*

A range of external factors were considered as important for the primary producers to adopt Web 2.0. They are maturity of technology, individual's confidence with the technology, as well as the different character of products produced, industry regulation, attitude and support from the industry associations in different sub-sectors.

These evidences support that the 'social and other external factors' is a determinant in the model.

8.4.2 MODERATORS

There were discussions about the moderators in the research model. These were gender, age, customer type (previous named as 'number of customers' or 'business complexity') and technology experience. Three possible moderators, comprising education background, firm size and firm position in supply chain were also discussed.

8.4.2.1 GENDER

All the participants were in agreement on the issue that gender is a moderator. FG2 and FG3 claimed that female members in the agribusinesses, often being the wife of the male farmers, are the people who generally manage ICT and most in-house works, while the male farmers are responsible for the production. So there is a gender difference in ICT use. FG3 said:

> *"When we actually ran some training course in business stuff to do with, you know, where the business is at, sort of looking at financials and things like that and in 9 out of 10 of those cases it was the female partner in the business that fronted up to that and knew all the facts and figures, and started talking facts and figures to the bloke."*

Nonetheless, FG2 pointed out that the moderating effect of gender is more obvious for middle age farmers, and the effect, in general, is fading. FG2 said:

> *"So I suspect that, you know, that in the medium age group and that older age group that maybe it might be something the ladies are doing that (ICT related work) and I think FG4 has pointed out that the younger blokes are using smart phones and those sorts of applications."*

FG1 argued that the position of the female in the agribusiness is also related to the Web 2.0 application. He thought, in the family based agribusiness, the female members could be further sorted into two groups, the women who actually make important business decisions and the others simply look after record keeping and accounting. The female making important business decisions may have significant impacts on the ICT application while the others may not. FG1 said:

> *"There is another factor in there. It could be about whether they are recording and managing, or whether they are driving the business output. In the example we have had today, this is about driving the business output."*

This evidence suggests that gender is a moderator. Since the relationship between gender and the determinants of the intention to use Web 2.0 technologies had not been specified in the focus group discussion, gender is kept as a moderator in the model and the relationships with the determinants have been left unchanged.

8.4.2.2 AGE

All the participants agreed on the proposal that age has a moderating effect in the research model. FG1 and FG4 held different opinions about the role that age plays in the research model. FG1 believed that age is a factor in ICT and Web 2.0 use because the younger generations grow up with IT and are naturally familiar with ICT use, and therefore they are, in general, not frightened of using ICT and may be more active in ICT application. This advantage, compared with the older generation, is considered as a factor influencing intention to use ICT applications in SCM. FG1 said:

> *"It (the age) is also driver. If you are a young person and the technology has been at your fingertips since you were three years old. And it is automatic, because it is the way your head works and your hands work. And you are not frightened of them."*

In complement to FG1, FG4 found that for a number of the young people, the use of ICT has become their natural means of communication, replacing handwriting and also impacting their hand writing skill and literacy to significant degrees. FG4 said:

> *"And the other thing I find is the literacy thing. Interesting, because I sort of come across a few young people that really do struggle with that sort of stuff. And yet seem to have ability to being able to use the technology."*

Nonetheless, FG2 pointed out that the moderating effect of gender is more obvious for middle and older age farmers. FG2 said:

> *"So I suspect that, you know, that in the medium age group and that older age group that maybe it might be something the ladies are doing that (ICT related work) and I think FG4 has pointed out that the younger blokes and the smart phones and using those sorts of applications."*

FG4 argued that age can be viewed as both determinant and moderator:

> *"So age probably falls into both."*

Consistent with other technology acceptance models 'age' is more appropriate to act as a moderator so it is included as a moderator in the model. According to the focus group participants, its effect on 'effort expectancy' is weaker for younger primary producers and stronger for their older peers. It means that Web 2.0 adoption is easier and more natural for younger farmers, which contrasts with the conclusion of survey. The situation can be explained in two possible ways. Firstly, although Internet use is prevalent, many primary producers, especially the older primary producers, used the Internet for information searches. Compared with their older peers, younger primary producers, in general, have adopted more active approaches such as information sharing, content contribution and even application development than the older peers. So, specifically in Web 2.0 context, younger primary producers are still experiencing less difficulty than their older peers. Secondly, and in contrast, other opinions given in the focus group indicate that the moderating effect of 'age' is fading as the technology become more standard.

8.4.2.3 CUSTOMER TYPES

'Customer types' referred to the characteristics of the agri-food SMEs' customers such as individuals or companies, firm sizes and trading volumes.

All the participants tended to be in agreement on the issue that the targeted markets and targeted customers of these agri-food SMEs may have a moderating effect in the research model. They concluded that there might be significant difference between the agribusinesses that sell to a small number of large companies, and the agribusinesses that sell to a large number of small companies or individual customers. FG2 said:

> *"Because they (the primary producers focusing on niche markets) tend to be the forward thinkers who usually are a little more across technology and the advantages of using technology for, you know, marketing intelligence gathering, and that type of thing. I would think…The market that they're supplying or the market that they are in would have a big influence on the usefulness of this sort of information. You know, the guys that are supplying stuff under contract to, you know, say, Simplot buyers, are going to be approaching things in quite a different manner to the ones that are supplying a specialty supplier of, you know, fancy little tomatoes or something like that."*

The focus group discussion suggests that 'customer type' may have moderating effects in the research model. It may be a more appropriate surrogate for the 'number of customer' that was used in the survey. Thus 'customer type' has replaced 'number of customers' and become the moderator in the model. Since the relationships between 'customer type' and each of the determinants have not been specified in the focus group, those relationships have been left unchanged in the model.

8.4.2.4 TECHNOLOGY EXPERIENCE

'Technology experience' is defined as the levels of experience in using similar systems. There was debate about the moderating effect of an individual's general ICT experience in the research model. As quoted previously, FG1 believed that the technology experience associated with age has a moderating effect in the research model. In particular, younger people generally have more ICT experience and are finding it less difficult to use ICT. FG1 said:

> *"It (the age) is also driver. If you are a young person and the technology has been at your fingertips since you were three years old. And it is automatic, because it is the way your head works and your hands work. And you are not frightened of them."*

FG3 argued that, in the case of introducing new technology to their SCM, the maturity of the SCM technology that is being introduced and the confidence about the technology may be more important than the personal experience of SCM applications.

> *"If it is about introducing new technology, I wonder whether there is an issue there about the maturity of the technology itself and whether an individual's confidence in the technology might actually have an influence as well. So not necessarily that I have had personal experience, you know."*

Although there are differing opinions regarding the moderating effect of 'technology experience' the indicative findings gained from both the survey and the focus group have supported the strong relationship between technology experience and effort expectancy. The focus group participants believed that, naturally, the primary producers with more technology experience may have less estimated effort for the Web 2.0 applications in SCM. Thus the primary producers with more ICT experience may have weaker feeling about the importance of 'effort expectancy'. This is in contrast to the survey result where the interviewees with more 'technology experience' were more concerned about the expected effort to apply ICT to SCM. The possible reasons are because they can see the potential difficulties when they have more technology experience.

These contradictory findings can be explained in two possible ways. Firstly, there may be bias caused in categorising the technology experience groups. In the survey analysis, the interviewees were sorted into either 'more technology experience' or 'less technology experience' by their answers regarding whether they have used any software in their SCM. The low experience interviewees may not be able to describe the actual use of SCM software due to their limited understanding of the SCM software. The consequent result, based on that categorisation, may deviate from the fact. Secondly, the conversations indicate that there is a difference in the perception of 'technology experience' between the survey and the focus group discussion. The discussion about 'technology experience' in the focus group referred to more general ICT experience rather than specific experience of SCM application that were used in the survey.

The weakness in sorting the 'experienced users' and 'unexperienced users' in the survey may have substantial impact on the accuracy of the subsequent survey analysis so the outcome from the focus group may be more reliable. The findings from the focus group suggest that the primary producers with more 'technology experience' may have less estimated difficulty in applying Web 2.0 to their SCM. However the findings may require further investigation in future research. More importantly, whether the general technology experience or specific experience of SCM applications may have impacts on the 'effort expectancy' requires further investigation.

Since the focus group had little discussion about specifying the relationships between technology experience and other determinants, those relationships have remained in the model.

8.4.2.5 OTHER POSSIBLE MODERATORS

The focus group discussed some other possible factors that may have moderating effects in the research model.

8.4.2.5.1 SIZE AND FIRM POSITION IN THE SUPPLY CHAIN

FG3 suggested that size and firm position in the supply chain could also have moderating effects in the model by pointing out the different applications of Web 2.0 in large and small agribusinesses. FG3 referred to the previous discussion that the large agribusinesses were inclined to use Web 2.0 for marketing and for obtaining feedbacks for new product developments while small agribusinesses generally consider it as a way to promote sales. FG3 said:

> *"I wonder whether there is a difference, maybe even in the modifier area about the size of businesses and the position within the supply chain. Because you were are talking about the organization at the much larger end, and using these things for marketing and feedback, and the smaller, kind of primary producers perhaps using them for development like the example we saw, or actually using them for direct sales."*

This result suggested that the firm size and position in the supply chain may also be moderators, which corroborate the ideas of Burke (2010) who found that firm size had an impact on farming entrepreneurs in adopting ICT. However, in the study, the agri-food SMEs operated by a small number of family members are the focus in this research, so there is insufficient data to identify the effect of firm size. Firm size is therefore not included in the research model, and may need to be investigated in future research.

The research project focuses on SMEs, especially the primary producers in the upstream of the agri-food supply chain so the firm position is not the focus and may require further investigation in any future study.

8.4.2.5.2 EDUCATION BACKGROUND

FG4 suspected that illiteracy may be irrelevant for their ICT adoption; conversely it may be a driver for them to use ICT which may permit them to overcome the disadvantages of illiteracy.

> *"And the other thing I find, I, the literacy thing. Interesting, because…. I sort of come across a few young people that really do struggle with that sort of stuff. And yet seem to have ability to being able to use technology … The technology allows that hurdle to be jumped immediately really to some degree."*

FG1 agreed with FG4 and thought that the illiteracy of some of the younger generation might be attributed to the way that their education had been approached. He said:

> *"There is nothing wrong with their brain. It is the way they were taught to read."*

Focus group participant FG4 suspected that a higher education background may need to be specified rather than just the general education in moderating other determinants in the research model. FG4 said:

> *"Higher technology education background … I don't know. FG2 could probably comment about it more than me. You know, I am not a technology person, really, am I? I never have been."*

These findings indicate that general education level may not have an impact in the Web 2.0 adoption. The exclusion of education as an influencing factor is consistent with the finding of

Burke (2010), who has ascertained that there is no strong relationship between the agribusiness owners' education level and ICT adoption.

Although some interviewees have reported their education background, the complexity of their educational backgrounds makes it impossible for further comparison and analysis in this research. So the general education background has not been used as a moderator incorporated into the RuWebTAM version 3. Due to insufficient data in the study, the moderating effect of a high technology education background as mentioned in the focus group discussion may need to be investigated in future research.

8.4.3 VALUE AND WEAKNESS OF THE MODEL

Apart from the model validation, another goal of the focus group discussion was to assess the value of the model.

Regarding the value of the research model, FG1 asked:

> *"Why is it relevant or important to have this model, whatever it turns out to be?"*

The moderator (person) answered:

> *"Well, why might it be useful, I suspect it might be useful to somebody who is thinking about designing an application? What kind of an application would you want to build if you are trying to build an application for use within this environment?"*

With respect the usefulness of the research model, the moderator (person) said:

> *"So it is beginning to sound to me like the kind of people who might find it most useful are going to be people like your advisory group who might find that they could use this as a framework."*

And FG1 answered:

> *"It seems to me that there's value there."*

FG3 pointed out the weakness of this research model in that it has not incorporated the ICT diffusion process into this model. The ICT diffusion process can provide an orthogonal view of the problem.

> *"So maybe a lot of these people aren't early adopters. Maybe they are, you know, fast followers or whatever. Those crazy things that people like to actually call them. So those things might be diffusion and all that kind of stuff. It provides a different perspective"*

The usefulness and weakness of the research model can be summarised as follows. The research model was presented as being useful in two ways:

- for the Web 2.0 application developers to analyse software requirements;
- for the advisory group to use it as a framework to help people make decision about Web 2.0 adoption.

Inability to demonstrate the changing perception regarding Web 2.0 adoption is considered as a weakness of the model.

8.4.4 CONCLUSION OF FOCUS GROUP

This section concludes the outcomes of the focus group by answering the set objectives and the SRQ 5 and SRQ 6.

8.4.4.1 ANSWERING THE OBJECTIVES OF THE FOCUS GROUP

Answers of the 2 objectives are provided as follow.

8.4.4.1.1 ASSESSING THE ACCURACY OF THE RESEARCH MODEL AND ITS COMPONENTS

The focus group participants agreed that the research model was accurate; nonetheless a number of suggestions were made for improvements.

The determinants and their relationships with the moderators in the final model are summarised in Table 8-1. The modified fields are highlighted.

Table 8-1: Relationships between Determinants and Moderators in RuWebTAM 3

Determinants	Moderators	Explanation in Survey Before Validation	Explanation After Validation
Performance Expectancy and Lifestyle Enhancement	Age	Effect stronger for older primary producers	No change
	Gender	Effect stronger for female primary producers	No change
	Customer Types	Effect stronger for primary producers with large number of retail customers	No change
	Technology Experience	Effect stronger for primary producers with more technology experience	No change
Effort Expectancy	**Age**	Not available	**Effect stronger for older primary producers**
	Customer Types	Effect stronger for primary producers with small number of retail customers	No change
	Technology Experience	Effect stronger for primary producers with more technology experience	**Effect stronger for primary producers with less technology experience**
Communication Quality	**Customer Types**	Effect stronger for primary producers with a large number of retail customers	No change
Social and Other External Factors	**Customer Types**	Effect stronger for primary producers with a small number of retail customers	No change

8.4.4.1.2 DETERMINING THE OVERALL USEFULNESS OF THE RESEARCH MODEL TO THE AGRI-FOOD INDUSTRY

As discussed in 8.4.3, the research model was seen to be useful for Web 2.0 application developers to analyse software requirement, as well as for advisory groups to use it as a framework to help people make decision about Web 2.0 adoption.

8.4.4.2 ANSWERS OF SRQ5 AND SRQ 6

The answers of SRQ5 and SRQ6 which were provided by the focus group participants are summarised as follow:

SRQ5: What differences exist between each agri-food sub-sector in applying Web 2.0 technology to their supply chain?

The focus group participants decided that due to different product natures, customer types and industry governance the operation of each agri-food supply chain varies, and therefore the application of Web 2.0 will differ in many ways.

For example in the seafood sub-sector, especially the abalone and lobster supply chains, their high value products, export oriented markets and quota system make them suitable to voluntarily adopt some types of Web 2.0 technologies to keep catch records and to explore the direct sales channel; while in the livestock supply chain, the hygiene requirement and low unit value make it more suitable for commodity production and sales, and there are no obvious advantages for implementing Web 2.0 technologies at this stage.

SRQ6: How effective are Web 2.0-based approaches to supply chain management for Tasmanian agri-food SMEs?

The focus group participants concluded that Web 2.0 approaches may enhance many key areas of the Tasmanian agri-food SMEs’ supply chain activities such as record management, marketing and customer service. The Web 2.0-based approaches provide an easy-to-use, affordable and collaborative solution for those agri-food SMEs to embark on ICT to overcome the challenges faced in their supply chain management.

However, their effectiveness is also dependent on the way that the agribusinesses are oriented, and therefore their need and demand for ICT use. For example, the agribusinesses focusing on commodity production may have different opinions about the effectiveness of ICT compared to the agribusinesses involving in direct retail sales.

8.5 Final Model

This section presents the evolution of the research model and summarises the definitions of the determinants and moderators.

8.5.1 Evolution of the Research Models

The original research model shown in Figure 8-2 is developed based on a number of different Technology adoption models and presented in Chapter 3 Literature Review.

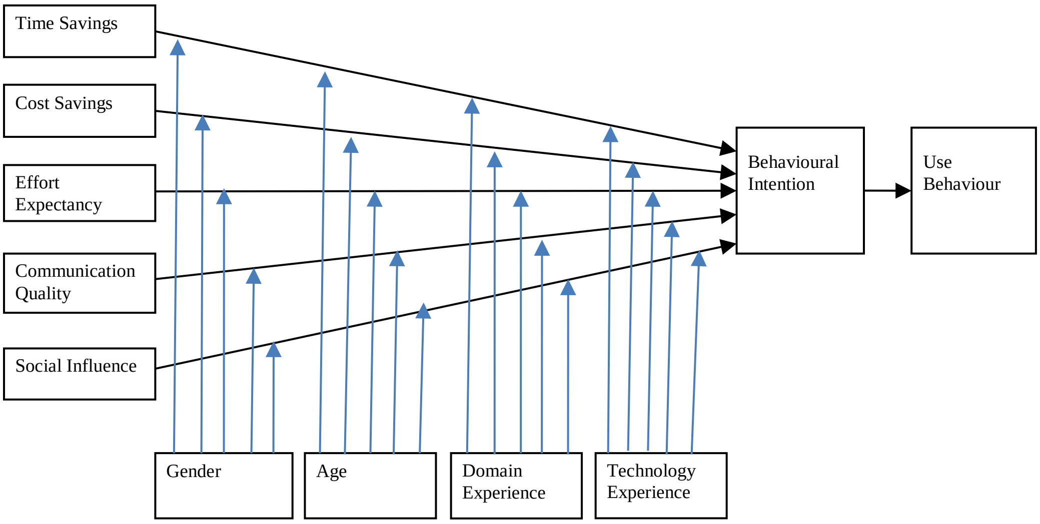

Figure 8-2: RuWebTAM

The model has been revised based on the data gathered from the survey, which is presented in Chapter 7 Survey Analysis for Model Modification. As shown in Figure 8-3 the revised model RuWebTAM 2 includes 4 determinants and 4 moderators. The changes over the original models, RuWebTAM, are highlighted in red.

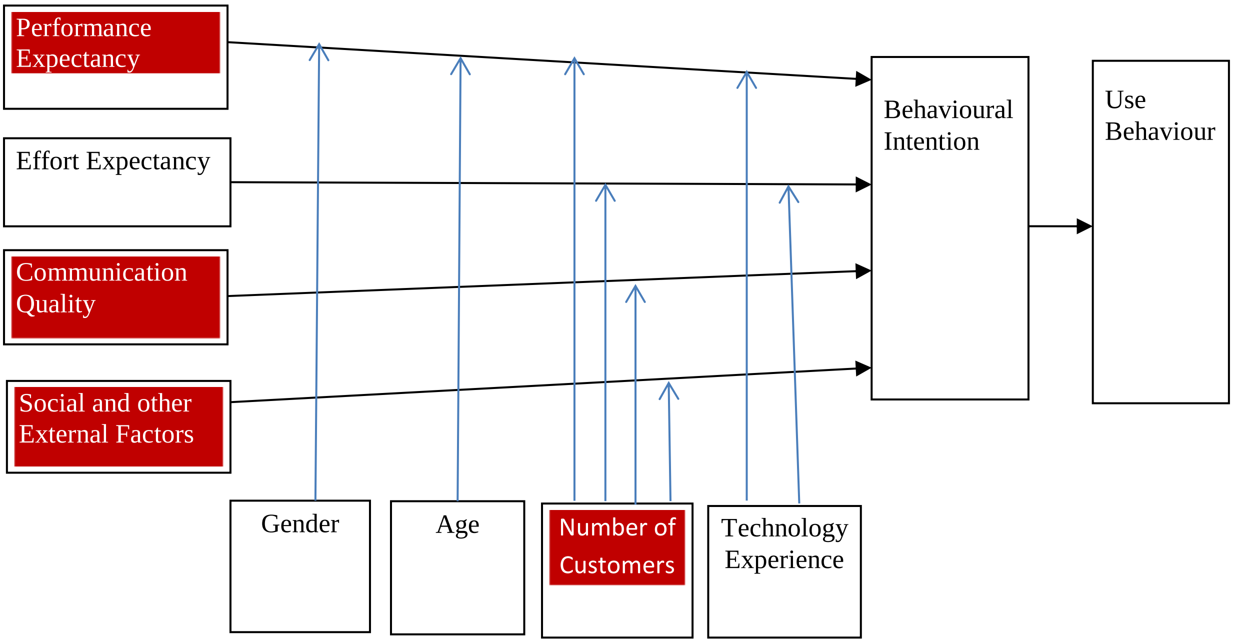

Figure 8-3: The Revised Model - RuWebTAM 2

The revised model was validated by the focus group discussion presented in Section 8.4 'Focus group description'. Based on the justification presented in Section 8.4, the research model has been finalised. The final research model - Rural Web 2.0 Technology Acceptance Model 3 is shown in Figure 8-4. The changes over the revised models, RuWebTAM 2 are highlighted in red.

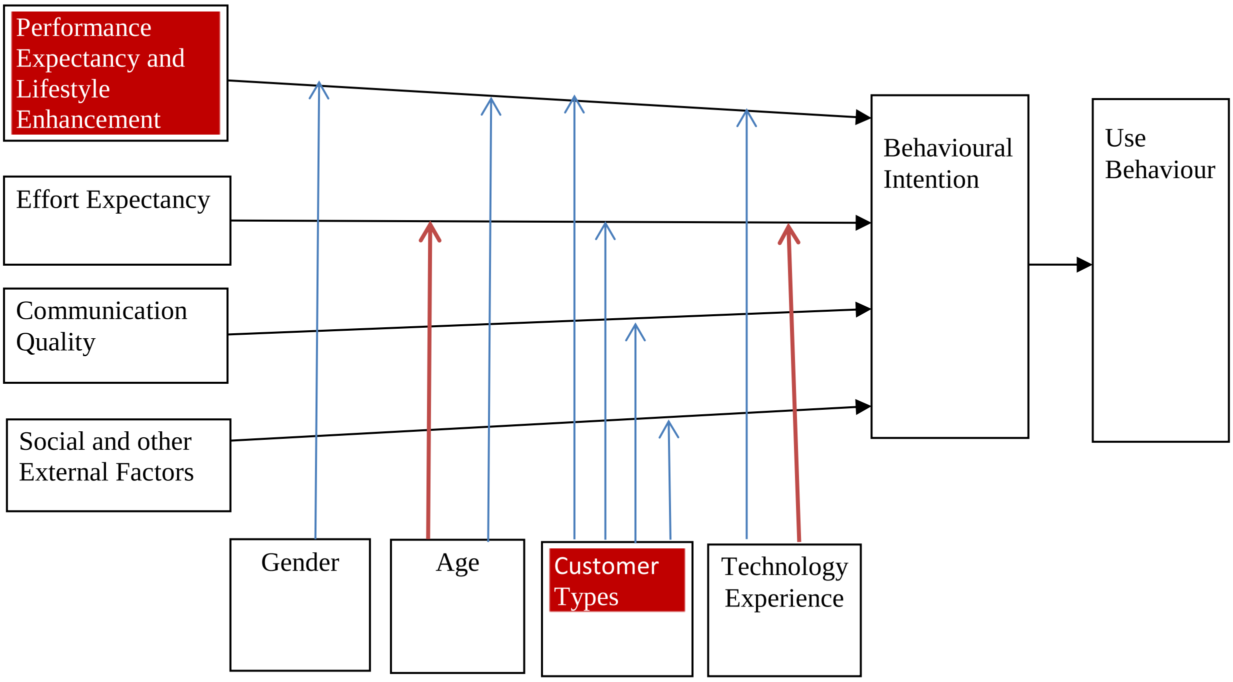

Figure 8-4: The Final Model - RuWebTAM 3

8.5.2 DEFINING THE DETERMINANTS AND MODERATORS

The definitions of the determinants and moderators in the RuWebTAM 3 are presented as the follows.

'Performance expectancy and lifestyle enhancement' is defined as the degree to which an individual believes that using the system will help him or her to attain gain in job performance or/and lifestyle enhancement as well as enhance the business performance.

'Effort expectancy' is defined as the degree of ease associated with the use of the system.

'Communication quality' is defined as the degree to which an individual believes that he or she can use the system to achieve communication enhancement. The definition of 'Communication quality' is two-fold. One is the degree of communication enhancement associated with the use of the system, and the other is the magnitude of the challenges related to telecommunication infrastructures such as the Internet connectivity in rural areas, the Internet accessibility on the work site and the costs of the connection.

'Social and other external factors' is defined as the degree to which an individual perceives that important others or external factors may affect his or her use of the new system.

While ‘gender’ and ‘age’ are self-defined, ‘technology experience’ is defined as the levels of experience in using similar systems. ‘Customer types’ is referred to the characteristics of his or her customers such as individuals or companies, firm sizes of the customers and trading volumes.

8.6 CONCLUSION

This chapter has reported the final phase of the empirical study that was planned to validate the findings of the two previous data-gathering phases via focus groups with Tasmanian agri-food experts.

All of the participants tended to be in agreement on the issue that ‘performance expectancy’ is a determinant. The ‘performance expectancy’ was considered as a more general term that covers technology acceptance beyond ICT and Web 2.0 technologies. In addition, to include the motive of the primary producers without an ambitious plan to grow their agribusinesses, the more inclusive term ‘performance expectancy and lifestyle enhancement’ was proposed.

The results indicate that not all the agribusinesses are determined to grow. For the primary producers who do not focus only on growth and who consider farming as a lifestyle, Web 2.0 adoption may be because it can make their lives easier and happier.

The outcome suggests that the primary producers may have a priority on technology applications. They would prioritise the technology that is deemed to be most necessary and can bring obvious and immediate benefits to the agribusinesses. This can possibly explain the reasons why many primary producers prioritise the adoption of production technology over ICT.

All of the participants tended to be in agreement on the issue that ’effort expectancy’ is a determinant. The result indicates that the user-friendly systems and suitable devices permitting them to be used while at work are important for their adoption.

The ‘communication quality’ is considered as a distinguished strength that Web 2.0 can bring to the primary producers. All the participants agreed on communication quality as a determinant. The finding suggests that Web 2.0 can possibly play a significant role in communication evolution in the agri-food industry.

All the participants tended to be in agreement on the issue that ‘social and other external factors’ are an important factor in determining Web 2.0 adoption. The findings suggest that the application of Web 2.0 to SCM is not only a business decision at individual firm level but also influenced by a range of social and external factors such as family supports, industry readiness, and the character of the products.

All of the participants agreed that ‘gender’ and ‘age’ are moderators that affect those determinants, but that such effects are fading. The finding suggests that currently, although the male producers or older primary producers generally have less ICT knowledge than the female members or younger primary producers in the family businesses, the situation is going to change substantially as the younger primary producers grow up and inherit the farm in future. The younger primary producers, regardless of gender, after growing up with the ICT may have sufficient ICT knowledge to apply them into the businesses.

The outcome of the focus group discussion suggests that ‘customer types’ is a moderator in the research model. This indicates that the primary producers who deal with a large number of retail customers are likely to supply to end customers, and therefore need to manage the marketing and customer service themselves. Currently Web 2.0 has illustrated great potential in these domains, so the primary producers with a large number of retail customers may be more positive on the advantages of Web 2.0 applications.

The ‘technology experience’ is believed to be associated with age by the focus group participants, and in particular, younger primary producers, in general, have more experience in using ICT and therefore may be more positive for applying Web 2.0 to SCM. This is contradictive to the findings gained in the survey. The different opinions about the moderating effect of ‘technology experience’ suggests that ‘technology experience’ may possibly be a moderator, however, what kind of technology experience would have moderating impacts in the research model needs to be further investigated.

Based on the outcome of the data validation, the research model is finalised. Now that all stages of empirical data collection and analysis have been discussed, the next chapter will conclude the entire research project.

Chapter 9

Conclusion

9.1 INTRODUCTION

The outcome of the last stage of the empirical data gathering, a focus group for data validation, was presented in the previous chapter. This is the last chapter in this thesis and it concludes the entire research project.

This research topic consists of three major areas of focus – Web 2.0, agri-food SMEs, and their supply chain management. The popularity of the social technologies, social media and smartphones has led to an increasing amount of interest in Web 2.0 technologies. As is the case with the economy in general, SMEs comprise the majority of business in the agri-food industry. Indeed they form the basis or core of the industry (ABS 2012a, 2012b). Over past decades, the agri-food SMEs have suffered from a range of challenges such as high inputs, low market prices and natural disasters. In the new global economy a number of significant changes have occurred. These include globalisation, concentration and industry dominance by supermarkets among others. Moreover, the competition in the agri-food industry has evolved from firm level to supply chain level. These issues led the researcher to formulate the primary research question of this research project; whether agri-food SMEs can use Web 2.0 to enhance their supply chain management and achieve better outcomes.

The remained of this chapter is organised as follows. Section 9.2 reviews the project. Section 9.3 summarises the answers to the subsidiary research questions. The contributions of the research, both theoretical and practical are discussed in Section 9.4. This is followed by Section 9.5 which addresses the limitations of the research. Finally, Section 9.6 directs attention at possible future work and Section 9.7 concludes the whole chapter and the thesis.

9.2 PROJECT SUMMARY

The goal of this project has been to discover whether Web 2.0 technologies can enhance the SMEs' agri-food supply chain management.

The research project began with a literature review to understand previous research on the thesis topic before conducting several stages of empirical data collection.

The empirical data collection consisted of three stages; key informant interviews, surveys and a focus group. The key informant interviews were designed to gather an overview of each sub-sector that was to be investigated. The information gathered from the ten key informant interviews provided a broad understanding of each agri-food supply chain.

After the key informant interviews both quantitative and qualitative data was collected through a survey of agri-food SMEs (most of whom were primary producers). Semi-structured interviews based on a designed questionnaire were employed as the data gathering technique for the survey. This resulted in 28 usable interviews from across Tasmania.

Given that the primary producers were not expected to have much time to spend on the project, the interviews were kept short. The preliminary data analysis of the survey data showed that there was some essential information missing. Thus, ethics approval was obtained to extend the survey by adding a follow-up interview with those participants. Unlike the face-to-face interviews in the original survey, these interviews were largely carried out by email and telephone given that a relationship had already been established with the interviewees. This resulted in 13 follow-up interviews covering all the sub-sectors, comprising the seafood, diary, livestock, fruit and vegetable sub-sectors. The follow-up interviews provided supplementary information to explain the reasons for their answers in the original questionnaire.

A focus group was employed as the last stage of empirical data-gathering to validate the findings. Four participants with considerable knowledge and experience of the topic participated in the focus group, which was driven by an experienced facilitator or moderator.

The planning, design and execution of the research is summarised by the following chapters.

- Chapter 1: an introduction to the Australian agri-food industry. highlighting the existing problems and challenges faced by family businesses (effectively SMEs) in the agri-food industry in managing their supply chains;
- Chapter 2: a comprehensive review of the literature covering six topics. The specific topics are as follows: evolving agri-food supply chains, SMEs and supply chain management, Web 2.0 technologies, Web 2.0-enabled supply chains, the NBN issue, and a number of technology acceptance models. The review of the literature provided the knowledge underpinning the development of the research model RuWebTAM. As a result, one main research question and six subsidiary research questions were developed to fill the literature gap;

- Chapter 3: a description of the underlying research methodology and the research design guiding the research process, addressing the survey research method and the semi-structured data gathering technique;
- Chapter 4: a summary of the ten key informant interviews which provided overviews of four important sub-sectors in the Tasmanian agri-food industry. The specific sub-sectors chosen were as follows: seafood, dairy, livestock, fruit and vegetable. The fruit and vegetable sub-sectors were discussed separately in later chapters as the fruit supply chain and the vegetable supply chain operations differed in a number of ways;
- Chapter 5: a description of the survey procedure and administration;
- Chapter 6: survey analysis of 28 agri-food SMEs who were predominately primary producers in the seafood, dairy, livestock, fruit and vegetable sub-sectors from across Tasmania. As the first part of the survey analysis this chapter presents an overview of the survey results and a description of each agri-food supply chain in terms of ICT and Web 2.0 use.
- Chapter 7: as a second part of the survey analysis the effect which the empirical data gathered in the survey had on the determinants and moderators of the RuWebTAM and their interactions are discussed. The outcomes illustrate the revised model which emerged from this phase of the research project
- Chapter 8: data validation via a focus group, with modification of the final research model;

The literature review and each stage of the empirical data collection answered one or more of the SRQs. The next section provides the explicit answers which were found for each of the SRQs.

9.3 ANSWERING THE RESEARCH QUESTIONS

This section presents the answers for each Subsidiary Research Question (SRQ). The aggregate findings therefore answer the over-arching research question that is presented in the end of this section.

SRQ 1 What evidence exists that SMEs in the agri-food sector can use Web 2.0 technology to link more efficiently with their supply chains?

Web 2.0 technologies are characterised as affordable, easy-to-use, interactive and collaborative solutions for agri-food SMEs (ABC News 2012; Adebanjo & Michaelides 2010;

James 2010). Their potential to assist the agri-food SMEs to enhance their performance in managing supply chain activities are seen to be becoming more credible (ABC News 2012; Adebanjo & Michaelides 2010; Sideridis et al. 2010; Teng et al. 2012).

As an example of downstream supply chain operations using Web 2.0, a citrus grower in South Australia has employed Web 2.0 technologies to connect with their customers and market their products online (ABC News 2012). By using these Web 2.0 applications, the grower has established mutual communication between growers and end customers which helps them obtain feedback from the customers thus helping with future planning (ABC News 2012).

Adebanjo & Michaelides (2010) believe that Web 2.0 can facilitate participation, enhance connectivity and help coordinate members in such a way as to benefit from information sharing, collective learning and joint bulk purchasing and thus gain from quantity discounts.

Web 2.0 appears to have great potential to improve information management and traceability. By using a number of Web 2.0 technologies, the Department of Primary Industries of Victoria Australia has proposed the FarmWeb 2.0 project. This project has been designed to enhance farmers' data management and facilitate a two way flow of data between government, industry and farmers/landholders (Department of Primary Industries 2012). Teng et al. (2012) have identified a number of features of Web 2.0 technologies that make it more advanced than desktop applications in enhancing livestock management with animal identification and traceability. These features include seamless system upgrades, constant software release cycles, easy technical support, wide accessibility, constant and real time synchronisation and data service integration.

Web 2.0, with its interaction and collaborative features, is considered an effective approach to enhancing communication and engagement in the primary producer's communities (James 2010). In the sea fishing industry, Chauvin et al. (2010) found that by using Web 2.0 technologies (in particular, the social networking function) fishermen can gain access to necessary information at the lowest possible cost.

SRQ 2 What frameworks have been developed to explain the use of Web 2.0 technologies?

Many technology acceptance models have been developed to explain the acceptance of technologies in general. These research models include TRA (Ajzen & Fishbein 1980), TAM (Davis et al. 1989), TAM 2 (Venkatesh & Davis 2000), TAM 3 (Venkatesh & Bala 2008) and The RuTADIM 1.2 Model (Lu & Swatman 2009), and UTAUT (Venkatesh et al. 2003). These models have the potential to be extended to explain the use of Web 2.0 technologies.

Each of those models has strengths and weaknesses. Given its compound nature and its competence in explaining the acceptance of ICT technologies, in this study UTAUT was chosen as the fundamental model for investigating Web 2.0 technology acceptance by Small and Medium Enterprises in the agri-food supply chains.

Based on UTAUT, the Rural Web 2.0 Technology Acceptance Model (RuWebTAM) has been developed to underpin the research project. RuWebTAM has been refined and modified using the empirical data gathered from the key informant interviews, the surveys, and the focus group. The final model, RuWebTAM3, contains four determinants and four moderators. The determinants are: 'performance expectancy and lifestyle enhancement', 'effort expectancy', 'communication quality' and 'social and other external factors'. The moderators are: 'gender', 'age', 'customer types' and 'technology experience'.

SRQ 3 How are individual SMEs using ICT for their supply chain management?

The outcomes from the key informant interviews and the survey indicate that the use of ICT in the agri-food SMEs' SCM could be summarised as limited, rudimentary and fragmentary. However, there were indications from the interviews that the situation was starting to change.

Email was the predominant ICT that the majority of the SMEs (89.3%, n=25) used in their SCM. Only a small number of SMEs (28.6%, n=8) reported that they had used some type of Web-based supply chain management platforms or particular software provided by their supply chain partners to manage their supply chain activities.

The majority of the agri-food SMEs interviewed have limited ICT use in one or two domains of supply chain management such as procurement, processing and inventory management, marketing and sales, transport and customer service. For example, the livestock farmers used AuctionsPlus to trade their livestock; a dairy farmer used the Alpro information management system developed by DeLaval company and some dairy farmers checked their milk results on Dairyweb; the vegetable farmers check the test report of products sales on the web-based application, McCain AgPortal, provided by McCain Foods (Aust.) Pty Ltd. However, in summary very few of them had applied ICT systems of any sophistication to their SCM.

However, a small number of primary producers are starting to apply ICT to manage more supply chain activities. For example, two interviewees (one in the dairy industry and the other in the seafood industry) have used a basket of ICT solutions to manage a range of their supply chain activities such as inventory management, marketing and sales, transport and logistics and customer service. Further to the above, a fisherman has developed an iPhone app to record his catch data and trace his fishing spots.

SRQ 4 What is the current state of agri-food SMEs' use of Web 2.0 in managing their agri-food supply chain?

Generally speaking, the survey results indicated that the use of Web 2.0 is even less than overall ICT use in their agri-food supply chain management. However, it was encouraging to discover that the majority of SCM applications used by the primary producers are web-based. This indicates that 'Web as a platform' (a key principle of Web 2.0) is becoming more standard; and therefore it also suggests that the acceptance of Web 2.0 technologies is increasing.

While Web 2.0 applications such as Facebook, Google, YouTube, Wikipedia etc. were used in personal and social ways by interviewees and their families, the primary producers had only used limited Web 2.0 applications in their SCM. The applications of Web 2.0 that were found were uneven across a range of supply chain management activities. In order of popularity, Web 2.0 applications were found in marketing, customer service, inventory management, logistics and transportation, procurement and traceability.

SRQ 5 What difference exists between each agri-food sub-sector in applying Web 2.0 technology to its supply chain?

Despite their general similarities, there were significant differences in Web 2.0 applications in the various agri-food supply chains. The differences can be attributed to a number of factors such as the character of the products and the structures of those supply chains.

From the primary producers' perspectives, the operations involved in the seafood supply chain (in particular, southern rock lobster and abalone) focusing as it does on export and wholesale were straightforward, so there was limited Web 2.0 and ICT used. However, the situation is starting to change. In order to explore the domestic market, Web 2.0 applications have been used for online sales and for improving their interactions with the end customers. Because of the quota system, data records are important in the seafood industry. A Web 2.0 application developed by a young fisherman has been used to record catch and traceability information. However the submission of digital data was not recognised by the authorised body when the interview was conducted, so there are problems of a non-technical nature to be overcome.

In the dairy sub-sector, the Web 2.0 applications in use can be divided into two groups. One group of Web 2.0 applications is those used by the primary producers who mainly supply to the large processors, and the other group is those Web 2.0 application used by those producers who supply to end customers outside the main dairy supply chain which is dominated by the large processors.

In the first group, the primary producers just need to focus on production, and they mainly use web-based systems provided by the large processors to check the report of their products as they are delivered. In the latter group, there are more extensive Web 2.0 applications in use as the primary producers need to manage most of the supply chain activities themselves as well as the production. Web 2.0 applications in use by the latter group were found to be for marketing and sales, order processing and inventory management, and in customer service.

In the fruit supply chain, there were only two interviewees. These individuals operated their agribusinesses in quite different ways, so it was not unexpected that their Web 2.0 applications were found to be different. One of the primary producers who focused on both wholesale and retail sales had used limited Web 2.0 as he considered that Web 2.0 would be little value given his simple supply chain operations. The other primary producer who runs his farm as a fruit picking experience site has used a considerable amount of Web 2.0 to improve customer service because he believed Web 2.0 is an important approach for interaction between customers and his agribusiness.

Regarding the vegetable supply chain, the primary producers who participated in the study were mainly supplying large processors under contracts and did not have to manage supply chain activities apart from production. Given this, it was not surprising to find that Web 2.0 had only been used by a small number of them, and that was to check on amounts delivered to processors and the results of their product quality.

The livestock farmers interviewed were found to have used few Web 2.0 technologies for the following reasons. Firstly, they do not have the facilities to process the livestock into meat for sale, and it was therefore difficult for them to sell the meat to their end customers directly so it was not necessary for them to apply Web 2.0 to enhance their marketing and customer service. Secondly they generally preferred to focus on production and to hire agents to handle the subsequent supply chain activities that required time and experience. As a result, although there are web-based applications such as AuctionsPlus for livestock trading, and NLIS for cattle registration, their use was limited.

The findings were discussed in more detail in Section 6.4 in Chapter 6.

SRQ 6 How effective are Web 2.0-based approaches to supply chain management for Tasmanian agri-food SMEs?

Web 2.0-based approaches were considered as a substantial improvement on previous SCM methods and an effective approach for the agri-food SMEs to enhance their SCM. Nonetheless, the empirical study indicated that Web 2.0 was more effective for some supply chain activities than others, and perception of the effectiveness might have been be affected by a range of factors.

The benefits of employing Web 2.0 technologies in SCM are improved communication and collaboration. Web 2.0 systems are also easier to implement, maintain and use because of the possibilities of seamless system upgrades, easy technical support, wide accessibility, constant and real time synchronisation, and data service integration. These features are enablers for the primary producers to enhance their SCM.

Web 2.0 approaches were more effective for some supply chain management activities such as marketing and customer service rather than procurement, inventory management, transport and logistics and planning and decision making. There are a range of reasons for this situation, such as ‘no need’ in the case of simple operations and ‘no suitable Web 2.0 applications’ in other cases.

Overall, the interviews also indicate that the primary producers’ age, gender, technology experience of using supply chain management applications and the customer types with which their businesses are involved may affect their perception of effectiveness.

The findings summarised in this section were discussed in more detail in Section 7.5 Moderators and Their Relationship with Determinants.

Over-arching Research Question: Can Small and Medium Enterprises in the agri-food industry, especially primary producers, use Web 2.0 technologies to enhance their supply chain management?

The empirical study has shown that Web 2.0 applications can enhance the agri-food SMEs’ supply chain management, so the answer to the over-arching question is a definite ‘yes’.

The agri-food SMEs have found that Web 2.0 can enhance their performance and management in a range of supply chain activities such as marketing and sales, order processing and inventory management, transport and logistics and customer service. As an exploratory research project this study clearly shows that Web 2.0 applications can provide an easy-to-use, affordable and collaborative solution for SME in agri-food supply chain. Thus, the use of Web 2.0 technologies and applications is an appropriate means for the agri-food SMEs (especially the primary producers) to overcome the existing challenges and enhance their SCM.

The research also provides a foundation for future projects in this domain.

9.4 RESEARCH CONTRIBUTIONS

The research has made both theoretical and practical contributions. The theoretical contribution includes drawing the Tasmanian agri-food supply chain diagrams, extending Web 2.0 literature to the agribusiness domain, and extending the application of UTAUT to the Web 2.0 domain. The practical contributions are exploring the business potential of Web 2.0, comparing Web 2.0 applications in different sub-sectors, assisting with requirement analysis for software developers, providing an adoption framework for advisory groups and investigating the potential benefits of the NBN expansion.

9.4.1 THEORETICAL CONTRIBUTIONS

A number of theoretical contributions have been made in this research. These include:

- Drawing the Tasmanian Agri-food Supply Chain Diagrams

While there have been a number of research projects that have investigated the agri-food supply chains in Australia (DAFF 2007; Spencer & Kneebone 2012), studies focusing on Tasmanian agri-food supply chains are limited. Drawing on the empirical data gathering, this research has developed the agri-food supply chain diagrams in five different sub-sectors; seafood, dairy, livestock, fruit and vegetables. These diagrams have visualised the supply chains and enabled cross sectional comparisons in the agri-food industry. The ICT and Web 2.0 use related to the primary producers are highlighted in the diagrams in Chapter 6.

- Extending the Literature of Web 2.0

Web 2.0 is still in its infancy and is evolving without standardization or sophisticated implementation (Goh et al. 2007). Well accepted literature in the more traditional Web 1.0 field may not be applicable to Web 2.0 because in Web 2.0 the Web is not only static browsers, but also applications or platforms which permit the users to create/alter content and interact with other users. Many Web 2.0 studies focus on the educational (Andersen 2007) or social aspects (Vickery & Wunsch-Vincent 2007) of this innovation. Business studies of the effects and impacts of Web 2.0 are in very short supply. This research project has extended the existing Web 2.0 literature to the business domain.

- Extending the Applicability of UTAUT to the Web 2.0 field

The research has extended the use of UTAUT to the Web 2.0 domain and has resulted in the development of RuWebTAM. UTAUT is a widely cited technology acceptance model and previous researchers have applied UTAUT to Web 2.0 studies in online learning and social aspects (Lin & Anol 2008) but few studies have thus applied UTAUT to business use of Web 2.0. Existing research applying UTAUT to Web 2.0 in the business field has tended to focus on consumer online purchasing behaviour (Weinmann & Gaedke 2009) rather than SMEs' supply chain management. The UTAUT model underpinned this study and helped to explain the acceptance issue of Web 2.0 for SMEs. This study has also extended the applicability of UTAUT to the social software domain which will encourage collaborative and interactive activities via the Internet.

9.4.2 PRACTICAL CONTRIBUTIONS

The research project aimed to explore the business potential of Web 2.0. In particular, it investigated how Web 2.0 technologies might assist the primary producers to enhance their performance in managing a range of supply chain activities. The project has made the following practical contributions.

- Bringing the Awareness of Web 2.0 Business Potential to the Primary producers

A range of Web 2.0 technologies has become more standard, but most primary producers just considered them as entertainment and were not aware of their business potential. The project has brought the business potential of Web 2.0 to the awareness of the primary producers. As a result some of the interviewees have since applied a range of easy-to-use and affordable Web 2.0 technologies to their businesses, and achieved satisfactory outcomes.

- Comparing e-business Applications in Different Sub-sectors

The research project involved a cross-sectional comparison between a variety of supply chains in the Tasmanian food industry and thus provides a "horizontal" view which will enable Tasmanian farmers to make use of their counterparts' successful or unsuccessful experiences in web-based supply chain management. This experience will be valuable for the design of future implementations for a wide variety of primary producers.

- Assisting Requirement Analysis for Software Developers

The results and the research model have provided useful information which will assist Web 2.0 application developers to analyse software requirement. The research outcomes indicated that Web 2.0 does provide effective approaches for SMEs to manage their supply chain activities but there were significant difference between the ICT demands in the diversified agri-food industry and different positions in the same supply chain. It will be necessary to understand their specific requirement before software developers will be able to tailor the software to fulfil their demands.

- Providing an Adoption Framework for Advisory Groups

The research results and, in particular, the research model provides a framework for advisory groups assisting people to make decisions about Web 2.0 adoption.

- Investigating the Potential Benefits of the NBN

With the current-roll-out of the NBN across Tasmania, more primary producers will have access to it. This will provide them with the ability to overcome their current poor telecommunication and access to many of the features which will make Web 2.0 more attractive. This study has laid the foundation for further research to assist agribusiness SMEs to make the most of the NBN.

9.5 LIMITATIONS

This research project (like any study) has some limitations. These are related predominantly to the limited time and resources that are available for a PhD study. The major limitations of the research related to three aspects: scale, scope and time:

- Scale: The limited number of participants may have led to bias in the findings. The effect of this limitation, however, has been minimised by obtaining the qualitative data gathered from the semi-structured interviews;

- Scope: the primary producers involved in the survey were primarily located in Tasmania. This limited regional coverage means that the findings cannot be generalised to other developed or developing countries, or even necessarily to other states of Australia, without further research. This limitation, of course, is fairly typical for exploratory research;

- Time: the project has involved cross-sectional research undertaken in a number of different sectors but the limited longitudinal comparison means that this was a ‘snap-shot’ study, rather than one which also included an evaluation of changes over time.

9.6 FUTURE WORKS

The project was an explorative research and has shed light on a number of areas suitable for future research. Further studies on the current topic are therefore recommended as larger scale research, larger scope research, longitudinal research, diffusion model testing and vertical research in the e-business context.

9.6.1 LARGER SCALE SURVEY

Although the data gathered from these participants provided indicative findings, the comparatively small number of participants was an intrinsic drawback in the research due to limited resources and the time constraint of a PhD candidature.

The empirical study gathered data from 10 key informant interviews, 28 survey interviews and one focus group. More than 50 interviewees with industrial or research background related to agri-food, ICT and SME domains from across Tasmania participated in the study. In comparison with the total population of primary producers in the state, the participants would only account for a tiny percentage. The small number of participant led to the inability to investigate the impacts of several factors such as education background and firm size.

In order to provide a more generalizable and representative outcome, further research should investigate a larger population and collect more quantitative data to supplement this research.

9.6.2 NATION WIDE RESEARCH

The research study has only focused on the agri-food SMEs in Tasmania, and therefore more research on this topic needs to be undertaken with a larger scope.

To achieve a meaningful result, the study focused on the SMEs in just one region of Australia – the predominantly rural island state of Tasmania – where the relatively limited number of participants was big enough to be representative of the entire group of primary producers, yet small enough to be manageable by one researcher. However, the agri-food industry is a diversified industry which is very dependent on natural factors such as local climate, weather, soil and water, as well as social factors such as industry governance and even culture.

Thus a larger scope of research undertaken across many sub-sectors and in many different regions within Australia and even around the world will be required for more representative and generalisable outcomes.

9.6.3 LONGITUDINAL STUDY AND DIFFUSIONAL MODEL TESTING

The research was a cross-sectional study and did not attempt to investigate changes in the findings over time. The focus group pointed out that the research model does not include the diffusional aspect of technology adoption.

The study investigated five different sub-sectors of the agri-food industry comprising seafood, dairy, livestock, fruit and vegetable. This produced a cross-sectional comparison of ICT and, in particular, Web 2.0 applications in agri-food SCM. Since ICT has been becoming more standardised, the primary producers were aware of the business potential of the Web 2.0 technologies and their perceptions of ICT have changed. For example, in a follow-up interview, an interviewee in the seafood sub-sector who had hesitated to apply ICT to his business has since then extensively implemented a range of ICT, especially Web 2.0.

A longitudinal study with more focus on the changing perception of interviewees and on the technology diffusion model is therefore suggested.

9.6.4 VERTICAL UNDERSTANDING OF THE WEB 2.0-ENABLED SUPPLY CHAIN

As designed, the study focused on the Web 2.0 application undertaken by the agri-food SMEs, especially on the primary producers. Future work is required to investigate the interaction and integration between members along specific supply chains. This may involve cross-cultural issues as it is common for agri-food supply chains to extend beyond the country's borders.

In addition, for better understanding, the prototype presented during the survey interviews was based on two popular Web 2.0 applications: Facebook and Google Drive (previously Google Doc). The simple and unified system comprised a range of Web 2.0 principles, but it was less capable in addressing the diversified ICT demands of the users in a range of sub-sectors and at different positions in the supply chains. Thus, a specific Web 2.0 SCM application with advanced functions such as procurement, inventory management and logistics that could be used to improve the supply chain performance may need to be developed as a part of any future research.

Outcomes of such future research will enhance the understanding of supply chain members with different goals, backgrounds and ways of doing business in a Web 2.0 environment.

9.7 CONCLUSION

The research project has investigated ICT use in agri-food supply chains in Tasmania in general, and in Web 2.0 applications specifically. Five Tasmanian agri-food supply chains have been drawn based on the research outcomes. They are the seafood, dairy, livestock, fruit and vegetable supply chains.

The research has provided indicative findings about the population in Tasmanian primary industries, an overview of the ICT use by SMEs (especially primary producers in the agri-food industry), and the current status of Web 2.0 applications in agri-food SCMs.

The survey results regarding the primary industry population was not very encouraging. It was noted that the primary producers were aging and that fewer of the young generation are determined to continue the work. (However, some people do leave their urban life and establish new agribusinesses in rural and remote areas.) Their communications were still dominated by conventional methods such as telephone and face-to-face. They seldom had good telecommunication infrastructure that was the equivalent to that of urban residents', and this was a constant challenge for further ICT use.

The findings indicated that ICT use was still limited and rudimentary in the agri-food SMEs. The primary producers have mostly used Web 2.0 technologies for entertainment but did not yet fully understand the business potential. However the situation is apparently starting to change.

Since ICT has been becoming more standardised, with the advent of smartphones and tablets, fragmentary but increasing amount of Web 2.0 use could be found in the agri-food industry. Of the SCM activities, marketing and customer service were among the popular domains for Web 2.0 applications.

In this study 'performance expectancy and life style enhancement', 'effort expectancy', 'communication quality' and 'social and other external factors' were found to determine the adoption of Web 2.0 applications in their SCM. The findings indicate that return on investment is a major factor in any decision to adopt ICT and Web 2.0. The owners of the agri-food SMEs would apply ICT and Web 2.0 to their SCM only when the perceived benefits outweigh the effort required for adoption. Constrained by limited resources, they must allocate their time and effort in a cost effective way and will not prioritise ICT and Web 2.0 if they do not offer real benefits.

The determinants were moderated by the agribusiness owners' gender, age, and technology experience, as well as with the customer types with which the agri-food SMEs are dealing.

It was found that female primary producers, in general, managed in-house operations and had a better understanding of the benefits of Web 2.0 applications. Younger primary producers, grown up in IT era, in general had better computer literacy and had little difficulty in adopting the Web 2.0 technology while, surprisingly, older primary producers were more interested in using ICT to enhance their SCM performance. The interviewees with more technology experience indicated that they are more positive toward Web 2.0 adoption than their peers with less technology experience. For the agri-food SMEs with a large number of retail customers, ICT and Web 2.0 were important for their operations and could significantly enhance their performance of SCM. As a result, the 'performance enhancement' and 'communication quality' improvement brought in by using Web 2.0 may have overshadowed and outweighed the effort required for the application as well as the possible influence of social and other external factors.

The research outcome has depicted the evolving landscape of ICT and Web 2.0 use in agri-food supply chains, and implied that the landscape will continue to evolve. For example, the majority of the applications used by the interviewees had evolved to be web based. Within a few more years, when the younger generation with sufficient IT literacy take over the agribusinesses and the technology continues to advance, it is believed that the application of Web 2.0 or more advanced web technologies in SCM could be prevalent and extensive.

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Appendix A

Appendix A: Survey Questionnaires and Follow-up Questions

Survey Questions

18 questions to be answered

Q.1 Which agricultural sector is your company in?

Livestock & Meat	○
Dairy	○
Vegetable	○
Fruit	○
Seafood	○
Others (please specify)	

Q.2 Does your company use the Internet? YES ☐ NO ☐

Q.3 Does your company use the National Broadband Network? YES ☐ NO ☐

Q.4 Does your business have a website or any online presence? YES ☐ NO ☐

Q.5 Which age group do you belong to?

Under 30 ☐ 30-39 ☐ 40-49 ☐ 50-59 ☐ 60 + ☐

Q.6 How many years have you been working in this sector?

Under 5 ☐ 5-9 ☐ 10-19 ☐ 20+ ☐

Q.7 Are you able to identify your customer groups? (Tick as many as necessary)

Food processors, e.g. Birdseye	○
Distributors	○
Restaurants, cafes, etc.	○
Food service providers to schools, airlines, hospitals, etc.	○
Supermarkets	○
Owners' outlets	○
Other retailers, e.g. health food stores, Coops, etc.	○
Other farmers	○
Online stores	○
Individual customers	○
Overseas customers	○
Others (please specify)	

Q.8 Could you please identify your supplier groups? (Tick as many as necessary)

Farm suppliers/ rural houses, e.g. Roberts, Elders, etc.	○
Agrichemical suppliers, e.g. Serve-Ag	○
Hardware stores, e.g. Mitre 10, Bunnings, etc.	○
Agricultural machinery suppliers e.g. John Deere, SOTA, etc.	○
Brokers (other than insurance brokers)	○
Other farmers	○
Online stores	○
Individual suppliers other than farmers	○
Overseas suppliers	○
Others (please specify)	

Q.9 How do you communicate with your trading partners (in order of frequency):

	Face to Face	Phone	Post	Fax	Email	Skype	Instant Messaging and Texting	Other (please specify)
A: Suppliers								
B: Customers								
C: Brokers								
D:Transport Companies								

Q.10 How satisfied are you with the way/s you currently communicate with your customers and suppliers?

Very Dissatisfied ☐
Dissatisfied ☐
Mixed Feelings ☐
Satisfied ☐
Very Satisfied ☐

Q.11 Please explain the reasons for your answer to Question 10

Q.12 Which of the following Information Communication Technologies (ICT) have you used to do business with your Supply Chain trading partners?

Email	○
Web-based supply chain management platform (e.g. eBay)	○
Particular software provided by the suppliers or the customers	○
Electronic Data Interchange (EDI)	○
Web EDI	○
Shared Electronic Documents	○
Other supply chain mgt. software (please specify)	

Q.13 How important were the following motives for **adopting** ICT in your Supply Chain Management? (please respond to each factor):

Factors	Important	Don't care	NOT important
Required by large customers	○	○	○
Better traceability	○	○	○
Better Book-keeping	○	○	○
Faster transactions	○	○	○
Better access to market data (e.g. market trend, consumer preferences, etc.)	○	○	○
Better access to experts outside the enterprise (e.g. Govt Depts, agronomists, etc.)	○	○	○
Better unit price calculation	○	○	○
Better customer service	○	○	○
Better transportation of our produce	○	○	○
Other (please specify)			

Q.14 How important are the following obstacles in **preventing you from using** Information Communication Technology in your Supply Chain Management (SCM) (please respond to each factor):

Obstacles	Important	Don't care	NOT important
Not accessible in field, i.e. available ICT devices lack mobility	○	○	○
Poor telecommunications infrastructure	○	○	○
High cost of telecommunications provider (e.g. Telstra)	○	○	○
Not willing to change our existing way of doing business	○	○	○
Lack of IT technical support	○	○	○
Lack of manager's support	○	○	○
Lack of staff with suitable training	○	○	○
Difficult to use	○	○	○
Negative comment from our community	○	○	○
Security reasons	○	○	○
Reliability of the SCM software	○	○	○
Flexibility of the SCM software	○	○	○
Other (please specify)			

The following questions are related to Web 2.0. For the sake of clarity, we have defined Web 2.0 as collaborative web-based solutions based on user involvement and contribution, e.g. Wikipedia vs. Encyclopedia Britannica; or Facebook vs. Bulletin Boards. You may not be using any Web 2.0 technologies yet, or may have little knowledge about this topic.

Q.15 Which of the following Web 2.0 applications have you used?

Search Engine	○
Facebook	○
Google Maps	○
Wikipedia	○
Twitter	○
YouTube	○
Google Docs	○
Blogs	○
Podcasts	○
Others (please specify)	

Web 2.0 Supply Chain Management prototype demonstration

Q.16 If you are using Web 2.0 for your Supply Chain Management, which of the following factors influenced you?

Factors	**Important**	**Don't care**	**NOT important**
Free system available	○	○	○
Accessible by mobile phone	○	○	○
Easy to use	○	○	○
Easy to interact with other supply chain members	○	○	○
Reduces IT investment	○	○	○
Allows integration of many sources (e.g. mashups)	○	○	○
Others (please specify)			

Q.17 Are there any **external** factors leading you to use Web 2.0 in your supply chain management, e.g. your suppliers or/and customers require it; your family members or friends recommend it; or the roll out of the National Broadband Network?

Yes ☐ Please list the external factors:

No ☐

Q.18 If you know of any agri-food supply chain projects you believe might be useful for this research, whether Web 2.0-related or not, could you please include a brief summary below – I would be especially grateful for a URL link to any relevant webpages or reports.

Follow-up Questions

Q1. Have you undertaken / completed any degree courses related to your agribusiness?

Q.2 (a) Could you explain your reasons for choosing to grow/breed just one type of produce on your farm?

OR

Q.2 (b) Could you explain your reasons for choosing to grow/breed more than one type of produce on your farm?

Q.3 Do you know where your products go after leaving the farm gate?

Q.4 If you are reluctant to apply ICT, would you be willing to explain why this is the case, given that some producers in your sector are using already using ICT for supply chain management?

Q.5 (a) Could you give me more detail about your motives for using ICT in your supply chain management, e.g. why did you say bookkeeping/recordkeeping is very important?

OR

Q.5 (b) Could you give me more detail about the obstacles you have faced in using ICT in your supply chain management, e.g. why do you think lacking reliability and flexibility of the supply chain management softwares are obstacles?

Q.6 Given that more than 90% of the interviewees ticked all the listed factors are important for using Web 2.0 in their supply chain management, including Free system available, Accessible by mobile phone, Easy to use, Easy to interact with other supply chain members, Reduces IT investment and Allows integration of many sources (e.g. mashups).

Could you give me more detail about your motives for using Web 2.0 in your supply chain management?

Appendix B

Appendix B: Main Ethics Approval

Main Ethics Approval

Social Science Ethics Officer
Private Bag 01 Hobart
Tasmania 7001 Australia
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Marilyn.Knott@utas.edu.au

MEMORANDUM

HUMAN RESEARCH ETHICS COMMITTEE (TASMANIA) NETWORK

UTAS

MINIMAL RISK ETHICS APPLICATION APPROVAL

26 July 2010

Professor Peter Marshall
Computing
Private Bag 87
Hobart

Ethics Reference: H11309

Web. 2.0 enabled integration of agricultural Small and Medium Enterprises with their food supply chain in Tasmania.

Dear Professor Marshall

Acting on a mandate from the Tasmania Social Sciences HREC, the Chair of the committee considered and approved the above project on 25 July 2010.

Please note that this approval is for four years and is conditional upon receipt of an annual Progress Report. Ethics approval for this project will lapse if a Progress Report is not submitted.

The following conditions apply to this approval. Failure to abide by these conditions may result in suspension or discontinuation of approval.

1. It is the responsibility of the Chief Investigator to ensure that all investigators are aware of the terms of approval, to ensure the project is conducted as approved by the Ethics Committee, and to notify the Committee if any investigators are added to, or cease involvement with, the project.

2. Complaints: If any complaints are received or ethical issues arise during the course of the project, investigators should advise the Executive Officer of the Ethics Committee on 03 6226 7479 or human.ethics@utas.edu.au.

3. Incidents or adverse effects: Investigators should notify the Ethics Committee immediately of any serious or unexpected adverse effects on participants or unforeseen events affecting the ethical acceptability of the project.

4. Amendments to Project: Modifications to the project must not proceed until approval is obtained from the Ethics Committee. Please submit an Amendment Form (available on our website) to notify the Ethics Committee of the proposed modifications.

5. Annual Report: Continued approval for this project is dependent on the submission of a Progress Report by the anniversary date of your approval. You will be sent a courtesy reminder closer to this date. **Failure to submit a Progress Report will mean that ethics approval for this project will lapse.**

6. Final Report: A Final Report and a copy of any published material arising from the project, either in full or abstract, must be provided at the end of the project.

Yours sincerely

MHorder

Melanie Horder
Ethics Officer

A PARTNERSHIP PROGRAM IN CONJUNCTION WITH THE DEPARTMENT OF HEALTH AND HUMAN SERVICES